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Application of the CorporateMetrics Methodology in Heineken Company

Aplikace metodologie CorporateMetrics ve společnosti Heineken

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4. CorporateMetrics Methodology Application in the Selected Company
5. Conclusion
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The declaration

"Herewith I declare that I elaborated the entire thesis, including all annexes independently."

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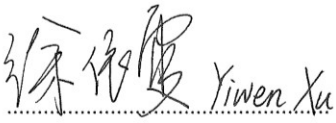


Bc. Yiwen Xu

Content

1. Introduction

Nowadays, under the situation of the acceleration of economy globalization, the economy becomes more and more open. Therefore, operating import and export business has already turned to an inevitable trend for lots of corporates. There is no doubt that being increasingly international as well as expanding markets will be beneficial for corporates. Nevertheless, when it brings the opportunity to corporates, it will also bring the challenge in the meanwhile. And the challenge refers to the market risk, which arises from the change of interest rate, exchange rate, commodity price, and equity price, etc. Thus, in order to transform the challenge into opportunity, it's really necessary for corporates to measure and manage such risk. And the CorporateMetrics methodology is exactly the method for measuring the risk. Therefore, our thesis will focus on applying CorporateMetrics methodology in our selected corporate to help it quantify the market risk when planning and making decisions.

The main goal of this thesis is to predict the probability distribution of net operating profits for Heineken company in 2019 by applying the CorporateMetrics methodology.

This thesis involves five chapters. The first chapter is introduction. The second chapter refers to description of the CorporateMetrics methodology. The third chapter describes the characterization of Heineken company. The fourth chapter is the key part of this thesis, it refers to the application of CorporateMetrics methodology in our selected company. And the last chapter is about conclusion.

In chapter 2, we will describe the CorporateMetrics methodology from four aspects. Firstly, we will give an overview of CorporateMetrics methodology according to its features, comparison with RiskMetrics methodology, and most essential part — procedures for applying the methodology. The rest part of this chapter will focus on various mathematic methods and financial models for conducting the procedures of the methodology. Next, we will introduce three types of mathematical methods for estimating the changes of input parameters, as well as three major kinds of probability distribution. Then, we will introduce two most commonly used financial model for generating scenarios. And the last part will be the briefly description of Value at Risk method for measuring the risk.

In chapter 3, we will concentrate on the characterization of our selected company, the

Heineken company from three main aspects. At first, we will give an overview of the basic information of Heineken company. Next, we will conduct global beer industry analysis to better understand the condition of Heineken company among the whole beer industry. And the last part will be about the SWOT analysis of Heineken company.

In chapter 4, we will apply the theories of CorporateMetrics methodology that we have mentioned in chapter 2 into the real practical part. This chapter is also regarded as the most important part of the whole thesis. We will use various mathematical methods and financial models for predicting the probability distribution of net operating profits for Heineken company in 2019 to achieve our main goal of this thesis.

In chapter 5, we will make a final summarization about all of above procedures, as well as drawing a conclusion based on the results that we have gotten about the past and future estimated values from the chapter 4.

2. Description of the CorporateMetrics Methodology

As we have mentioned in the introduction, the main goal of this thesis is to predict the probability distribution of net operating profits for Heineken company in 2019 by applying the CorporateMetrics methodology. Therefore, before the start of conducting the methodology, it's necessary for us to understand it. And in this chapter, we will make a description of the CorporateMetrics methodology from four aspects: overview of CorporateMetrics methodology, input parameters, financial modeling, and Value at Risk methodology.

2.1 Overview of CorporateMetrics Methodology

In general, the CorporateMetrics can be seen as a framework for measuring the market risk within the business environment of a corporate by using various of methodologies, data sets and software. The earnings and cash flow are two corporate financial results that CorporateMetrics commonly focus on. Due to the fact that these two results are usually used to determine the value of a corporate. Therefore, the CorporateMetrics allows a corporate to estimate the earnings and cash flow based on the prediction for the range of various market rates such as interest rate, exchange rate, equity prices and commodity prices, etc. Eventually, the market risk can be measured from the results of above prediction.

Moreover, the CorporateMetrics is designed in the form of a long-term prediction in consistence with the long-term management cycle which commonly exist in corporate planning and management.

2.1.1 Market Risk

Since we have known that the CorporateMetrics is a framework for measuring the market risk within the business environment of a corporate. Before having deeper understanding of CorporateMetrics, we need to identify the market risk first.

2.1.1.1 Classification of Market Risk

Market risk can be characterized as the possible losses from the future financial results in case of the fluctuation of market rate, and overall performance of the financial market. In general, market risk can be divided into four major categories, which are interest rate risk,

currency risk, commodity risk and equity risk.

- ***Interest rate risk***

This kind of risk involves the possibility of loss that the financial instruments such as fixed-income securities will suffer in situations where occurs unexpected fluctuations in interest rate.

- ***Currency risk***

Currency risk is also referred as exchange rate risk. This kind of risk is commonly accompanied by an uncertain loss in price changes of one currency in relation to another country's currency.

- ***Commodity risk***

Commodity risk represents a risk of loss as a result of price uncertainty of commodity-sensitive instruments.

- ***Equity risk***

This kind of risk is characterized as the risk of loss owing to fluctuations associated with the equity in corporates when purchasing or selling the stocks.

2.1.1.2 Comparison between Market Risk and Business Risk

Apart from market risk, there exist another type of risk which is similar to it, that is the business risk.

Both of business risk and market risk can lead to the uncertainty of future financial results achieved by the corporate. Nevertheless, for business risk, the uncertainty tends to be associated with the overall business environment in which the corporate deal with, as well as the business decisions which the corporate make. In other word, the business risk mainly arises from the corporate own operations. The factors such as imprecise investment strategies, wrong marketing strategies, inaccurate pricing tactics, etc. will cause the possible losses for the corporate.

In contrast, for market risk, the uncertainty tends to be related to the overall financial market condition, the fluctuations of market rates. Which also means that the factors such as interest rate risk, currency risk, commodity risk, etc. can result in the possible losses in the corporate.

Although different types of risk will cause the possible losses for corporate in a different degree. Be clearly aware of different approaches coping with these two different risks will be helpful for the risk management of the corporate.

2.1.2 Key Features of CorporateMetrics

After learning the basic concept about CorporateMetrics, next we will introduce the key features of it.

- ***Risk specification***

CorporateMetrics can measure risk such as Earnings-at-Risk (EaR), Earnings-per-Share-at-Risk (EPSaR) and Cash-Flow-at-Risk (CFaR). While Earnings-at-Risk (EaR) represents the maximum shortfall of earnings that may arise as a result of the impact of market risk on a specific exposure during a given reporting period and confidence level. However, nowadays some corporates prefer Earnings-per-Share- at-Risk (EPSaR) since earnings are reported as per share of equity basis. Similar to Earnings-at-Risk (EaR), Cash-Flow-at-Risk (CFaR) represents the maximum shortfall of net cash flow that may arise as a result of the impact of market risk.

- ***Methodology guidelines***

It describes the methods for recognizing and mapping market sensitivities, as well as the methods for calculating the market risk.

- ***Data sets and methods for long-term prediction***

The prediction is usually for long-term periods from two to twenty-four months.

- ***Website available***

The information of historical data, stress scenarios, long-term prediction can be obtained from the *website*[1].

2.1.3 Comparison between CorporateMetrics and RiskMetrics

As we have mentioned before, generally speaking, CorporateMetrics is a framework for measuring the market risk. So is the RiskMetrics. Nevertheless, there still exists lots of difference among them. The following Table 2.1 shows the comparison of risk management parameters in financial and corporate environments.

[1] http://www.riskmetrics.com

Table 2.1: Comparison of Risk Management Parameters in Financial and Corporate Environments

Parameter	Financial	Corporate
Framework	RiskMetrics	CorporateMetrics
Measure of value	Portfolio value	Earnings, cash flow
Accounting treatment	Fair value (market to market)	Accrual, fair value (market to market), hedge accounting
Horizon	Daily, monthly	Monthly, quarterly, annual
Benchmark	Market index	Specified targets (e.g., budgeted plan, spot, forward, expected and analyst forecast)

Source: LEE, Alvin Y. CorporateMetrics Technical Document [online]. New York: RiskMetrics Group, J. P. Morgan, 1999.

As is shown from the Table 2.1, the RiskMetrics is applied to predict the potential changes owing to the risk arising from market portfolios of financial instruments, which contains such as commodities, foreign exchange, equities, securities with fixed income, as well as their derivatives over the short time horizon from one day to one month. And the market index is regarded as the performance benchmark for measuring the potential loss of the value of the market portfolios.

In contrast, under the condition of following some key principles from RiskMetrics, the CorporateMetrics is more adapted to the corporate environment compared with RiskMetrics. While RiskMetrics is more appropriate in the financial environment. Due to the fact that CorporateMetrics concentrate on the corporate financial results like the cash flow and earnings instead of the market portfolios. Moreover, it estimates the corporate performance based on the specified targets rather than market index. Nevertheless, given the condition that the time horizon for predicting the corporate budget and plan is up to twenty-four months, the CorporateMetrics claims a longer time horizon of market rate data in comparison of RiskMetrics.

2.1.4 Procedures of Applying for CorporateMetrics

The procedure of applying for CorporateMetrics involves five steps, which are known as

metric specification, exposure mapping, scenario generation, valuation and risk computation. The whole process of these above five steps is called the simulation-based approach. And it constitutes the basis of the CorporateMetrics. By using this approach, the distribution of future financial results is generated through lots of market rates scenarios. In particular, one of the advantages of this approach is that it enables a corporate to describe the distribution of future financial results in detail. Thus, various risk measures will be obtained from it. Furthermore, this approach is extremely beneficial for the financial results of those corporates with nonlinearly relationship to market rates. These five steps can be seen as follows in detail:

1. Metric specification

As we have mentioned before, the risk measures include Earnings-at-Risk (EaR), Earnings-per-Share-at-Risk (EPSaR) and Cash-Flow-at-Risk (CFaR). Therefore, the first step of applying for CorporteMetrics is to determine which financial result will be analyzed, then, choose the corresponding risk measure to calculate. In addition, the time horizon and the confidence level also need to be specified. In our thesis, we choose Earnings-at-Risk (EaR) as our risk measure over three-year time horizon, besides, we will select 95% as the confidence level.

2. Exposure mapping

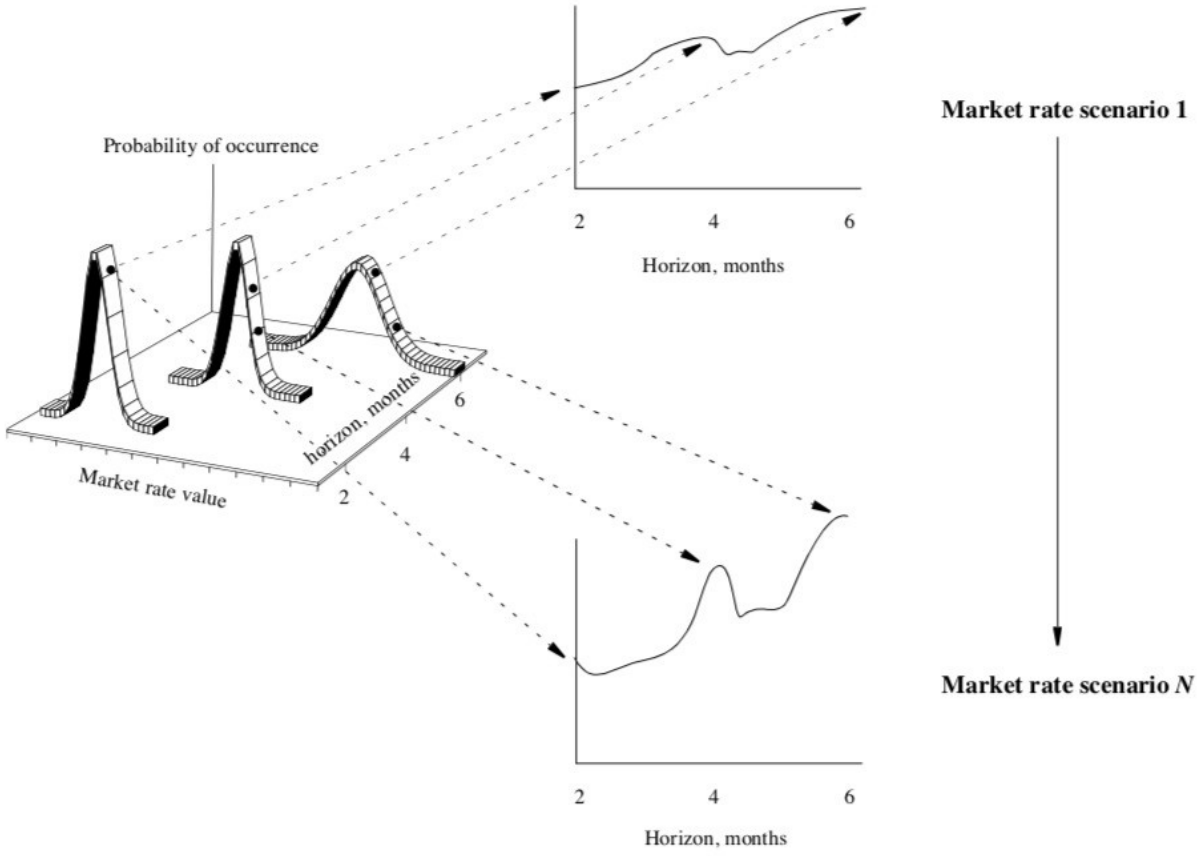
After specifying which risk measure to calculate, it is necessary to identify the financial results whose values may change due to changes in market rates, as well as how much they will be affected owing to the change of market rates. When performing this step, there are two crucial factors that the corporate must consider about. The first one is the scope of analysis. It emphasizes that the corporate need to use equations for expressing the financial results as a function of market rates, at that time, the chosen set of exposures can be analyzed according to the equations. And the second one is the types of functions. The corporate has to decide which type of function will be used to associate financial results with market rates. Nevertheless, whichever function is selected, what matters most is that it should adapt to the corporate's own business situation.

3. Scenario generation

The third step is essential but also very challenging for a corporate. It refers to the procedure for generating scenarios of the predicted market rates over a given time horizon. As

for generating the scenarios, firstly, the corporate need to specify the probability distributions for market rates. Next, each scenario will be developed by sampling the value from each distribution, eventually, all these values will be plotted as a function of time. Therefore, the set of all the scenarios defines a range of path that market rates are able to adapt the specified time horizons. There are lots of techniques for generating long-term scenarios that focus solely on mathematical modeling of market rate distributions. The three main approaches involve the usage of current market information such as the forward rates, econometric models and user-specified scenarios. The process of this step can be clearly seen in the following Figure 2.1.

Figure 2.1: Process of Generating Market Rate Scenarios



Source: LEE, Alvin Y. CorporateMetrics Technical Document [online]. New York: RiskMetrics Group, J. P. Morgan, 1999.

4. Valuation

A specific value for the future financial result can be obtained through inserting market rates for each scenario into the exposure map. By means of repeating the process for each scenario, the distribution of financial results is then obtained. In general, the process of valuation can be expressed as the exposure map that is recalculated at different market rates under the set of all scenarios. It refers to the calculation of the financial results by applying for

corresponding equations or calculate their components based on predicted market rates. Or even recalculate the pro forma statement for each scenario to predict financial results.

5. Risk computation

The last step involves the calculation of the sample statistics based on the distribution of financial results. As a result, the level of risk of the final distribution of financial results is determined and the statistical indicator is calculated. Statistical indicators are most often used to assess the risk of financial results, such as the standard deviation, confidence level, maximum shortfall relative to target and expected shortfall. The standard deviation is a measure of the symmetrical dispersion from the expected or average value of the predicted financial indicator. The confidence level represents the possibility that the financial result will not be lower than the specified level. The specific value of the confidence level is determined by a corporate decision based on the type of risk to be undertaken. Most commonly, 90%, 95%, and 99% will be set as the confidence level. The maximum shortfall relative to target is defined as the maximum amount by which the financial result may decrease compared to the value set by the business plan at a certain confidence level. The last indicator is the expected shortfall, which measures the average value of investment losses above a given confidence level.

2.2 Input Parameters

The input parameters are the results of observations during a given time series. In the meanwhile, parameters changes are also influenced by the risk measurement during observation periods. In this part, we will focus on the estimation of changes of parameters by applying the mathematical methods. In addition, with each parameter changes over time, it will have its own probability distribution. Therefore, we need to specify the types of probability distribution as well.

2.2.1 Estimation of Price Changes

The estimation for changes of parameters has well predictive ability and statistical properties. In this subchapter, we will introduce three mathematical methods which are able to reflect the revolution of the parameters, and then can be used for estimation of changes of parameters. And here we will use the parameter price as the example. There are three different

forms that can measure the changes of price. They can be expressed as the absolute change of price, relative change of price, and logarithmic change of price.

- ***Absolute change of price***

The absolute change of price refers to the difference between the value of price at time t and time t-1. The formula is shown as follows:

$$D_t = P_t - P_{t-1} , \tag{2.1}$$

where D_t represents the absolute change of price, P_t represents the price at time t, P_{t-1} represents the price at time t-1.

- ***Relative change of price***

The relative change of price is expressed as the ratio of absolute change of price and the price at time t-1. And relative change of price is commonly measured in percentage terms. The formula is shown as follows:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \cdot 100\% , \tag{2.2}$$

where R_t represents the relative change of price.

- ***Logarithmic change of price***

The logarithmic change of price is also called the continuous yield. And it's based on an assumption that the total gross price level equals to the term $(1 + R_t)$. The formula is shown as follows:

$$r_t = \ln(1 + R_t) = \ln\left(\frac{P_t}{P_{t-1}}\right) = p_t - p_{t-1} , \tag{2.3}$$

where r_t represents the logarithmic change of price, $p_t = \ln(P_t)$, and $p_{t-1} = \ln(P_{t-1})$.

In practice, the relative change of price and logarithmic change of price are most often used. Because instead of only concentrating on the change in terms of given price level, they focus more on the observed relationship between the price in two different time, which gives us a direct insight of the true scale of the difference.

2.2.2 Probability Distribution

As we have mentioned before, as each parameter changes over time, it will have its own probability distribution. There are three types of probability distribution that will be mostly used while modeling market price.

- ***Normal probability distribution***

The normal probability distribution is defined as a very common continuous probability distribution. It's quite important for both of the probability theory and mathematical statistics. The importance of normal probability distribution arises from the central limit theorem. In most general form, it points out that the averages of the samples of observations of random variable converges toward the normal distribution. When there exists large enough number of observations, they become normally distributed. The normal probability distribution is denoted by $N\ (\mu, \sigma^2)$. And it contains two parameters, which refers to mean μ and variance σ^2, where $-\infty < \mu < +\infty,\ \sigma^2 > 0$. The mean μ represents the average value, it measures the central tendency of the probability distribution. While variance σ^2 measures the deviation of a random variable from the mean value. The random variable x has a normal probability distribution if the probability density function $\mathrm{f}(x)$ is given as follows:

$$\mathrm{f}(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\left(\frac{(x-\mu)^2}{2\sigma^2}\right)}, \tag{2.4}$$

where all the variables have been explained above.

- ***Standard normal probability distribution***

Standard normal probability distribution can be seen as a special case of normal probability distribution while mean μ equals to 0 and variance σ^2 equals to 1. Therefore, the standard normal probability distribution is denoted by $N\ (0,1)$. And the random variable x has a standard normal probability distribution if the probability density function $\varphi(\mathrm{x})$ is given as follows:

$$\varphi(\mathrm{x}) = \frac{1}{\sqrt{2\pi}} e^{-\left(\frac{(x)^2}{2}\right)}, \tag{2.5}$$

where all the variables have been explained above.

- ***Logarithmic normal probability distribution***

Logarithmic normal probability distribution is denoted by $ln\ (\mu, \sigma^2)$, due to the fact that the logarithm of the random variable is normally distributed. The random variable x has a logarithmic normal probability distribution if the probability density function $\mathrm{f}(x)$ is given as follows:

$$\mathrm{f}(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot \frac{1}{x} \cdot e^{-\left(\frac{(lnx-\mu)^2}{2\sigma^2}\right)}, \tag{2.6}$$

where all the variables have been explained above.

2.3 Financial Modeling

As we have mentioned before, the most essential but also very challenging step of CorporateMetrics is the generation of scenarios for the predicted market rates over a given time horizon. And the procedure of scenarios generation relies on the application of some financial models. Therefore, in this subchapter, we will introduce some types of financial models for generating scenarios for the predicted market rates.

As is known to us, the changes of market rates are random. And owing to these random changes, the stochastic process is extensively used when generating scenarios. In briefly, the stochastic process can be seen as a collection of random variables ordered by an index set. Stochastic process can be classified into various categories such as Markov process, random walks, Gaussian process, etc. according to their mathematical properties.

But Markov process is the most commonly used among these models. The Markov process refers to the description of a set of possible events, where the probability of each possible event depends solely on the state obtained in the previous event. And within the Markov process, Wiener process is the most commonly used model. Wiener process is also called Brownian motion process as a result of its historical connection with the Brownian movement. Moreover, it plays an essential role in the whole mathematical science due to its widely application. The Wiener process is based on the following formula:

$$\tilde{z}_t - z_0 = dz = \tilde{z} \cdot \sqrt{dt} \ , \tag{2.7}$$

where $\tilde{z}$ represents a random variable of the normal distribution $N\ (0,1)$, and dt represents an infinitesimal time change.

The mean, variance and standard deviation for the Wiener process can be described as follows:

$$E(dz) = 0 \ , \tag{2.8}$$

$$var(dz) = t \ , \tag{2.9}$$

$$\sigma(dz) = \sqrt{t} \ , \tag{2.10}$$

where all the variables have been explained above.

After the basic description of the financial model for generating scenarios, next we will introduce two financial models in more details. They are random walk simulation and Mean-

Reversion model. For random walk simulation, we will mainly focus on the Geometric Brownian motion. And for Mean-Reversion model, we will mainly concentrate on the Vašíček model.

2.3.1 Random Walk Simulation

Random walk simulation involves a series of random steps which are used to represent a distinct random event. Through controlling the starting point of the simulation and the probability distribution of the random steps, we can use this simulation to see the different outputs of a given event. Although the random walk simulation is quite simple, it's still very useful and powerful. The most commonly used of random walk simulation is Geometric Brownian motion.

- ***Geometric Brownian motion***

Geometric Brownian motion is an important stochastic process of continuous time. In which the logarithm of random variables follows a Brownian motion with drift. Moreover, it's often used for modeling the financial parameters such as the price of stocks. Geometric Brownian motion with logarithmic price can be represented by the following stochastic differential equation:

$$dlnP = \hat{\alpha} \cdot dt + \sigma \cdot d\tilde{z} , \tag{2.11}$$

where $\hat{\alpha}$ represents the trend coefficient, σ represents the standard deviation, and $d\tilde{z}$ represents the random components that are equal to the product of random variables from the standard normal probability distribution $\tilde{z}$ and $\sqrt{dt}$.

And the trend coefficient $\hat{\alpha}$ can be expressed as follows:

$$\hat{\alpha} = \mu - \frac{\sigma^2}{2} , \tag{2.12}$$

where μ represents the average logarithmic price change, and it can be expressed as follows:

$$\mu = \frac{\sum_{t=1}^{T} ln\frac{P_t}{P_{t-1}}}{T} , \tag{2.13}$$

where P_t represents the price in time t, while P_{t-1} represents the price in time t-1.

Subsequently, it is possible to estimate random evolution of market price, mean value and variance, based on the following formulas:

$$P_t = P_{t-1} \cdot e^{(\hat{\alpha} \cdot dt + \sigma \cdot d\tilde{z})} , \tag{2.14}$$

$$E(P_t) = P_{t-1} \cdot e^{(\hat{\alpha} \cdot dt \cdot n)} , \tag{2.15}$$

$$var(P_t) = P_0^2 \cdot e^{(2 \cdot \hat{\alpha} \cdot dt \cdot n)} \cdot \left[e^{(\sigma^2 \cdot dt \cdot n)} - 1\right] , \tag{2.16}$$

where all the variables have been explained above.

2.3.2 Mean-Reversion Model

In contrast to random walk simulation, Mean - Reversion Processes can be used to predict the evolution of selected variables tend to return to long-term equilibrium value over a longer period of time. In the Mean-Reversion model, two basic parameters are included, which are the parameter a and parameter b. The parameter a illustrates the speed of approaching the long-term equilibrium. While parameter b represents the long-term equilibrium. All reverse processes contain a specific Wiener process.

Within the Mean-Reversion model, Vašíček model, Cox-Ingersoll-Ross model and Hull-White model are the most commonly used. But in this chapter, we will mainly focus on the Vašíček model. Through learning the knowledge from Vašíček model will be helpful for better understanding of the basic concept of Mean-Reversion model.

- ***Vašíček model***

Vašíček model can be used for describing interest rate movements driven by only one market risk source. There exists both arithmetic and geometric versions of Vašíček model. In the case of Arithmetic Vašíček model, negative values can be achieved, which means that it's not realistic in practice. Thus, in this part, the Geometric Vašíček model will be applied, and it will be tested whether the values are around their mean value. This model can be mathematically expressed by using the following formula:

$$dP = a \cdot (b - lnP) \cdot dt + \sigma \cdot d\tilde{z} , \tag{2.17}$$

where a and b represent the estimated parameters.

Subsequently, the least squared method can be applied. And the transformation to the linear shape can be obtained according to the following formula:

$$dP = \hat{\alpha} + \hat{\beta} \cdot P_{t-1} + \sigma \cdot d\tilde{z} , \tag{2.18}$$

where $\hat{\alpha}$ and $\hat{\beta}$ can be re-expressed as the initial parameters of mean-reversion model based on the least squared method:

$$\sum_{t=1}^{T}\left[L_t - \left(\hat{\alpha} + \hat{\beta} \cdot P_t\right)\right]^2 = \sum_{t=1}^{T} \varepsilon_t^2 \rightarrow \min , \tag{2.19}$$

where ε_t represents the residual at time t, which indicates the difference between the actual continuous and the modeled continuous yield. And by using the independent linear parameters $\hat{\alpha}$ and $\hat{\beta}$, the estimated parameter a and b can be calculated as follows:

$$a = -\frac{\hat{\beta}}{dt}\,, \tag{2.20}$$

$$b = \frac{\hat{\alpha}}{a \cdot dt}\,, \tag{2.21}$$

where all the variables have been explained above.

And the standard deviation of the Vašíček model for a given time interval can be expressed as follows:

$$\sigma = \frac{\hat{\sigma}}{dt}\,, \tag{2.22}$$

where $\hat{\sigma}$ represents the annualized standard deviation. And it can be expressed as follows:

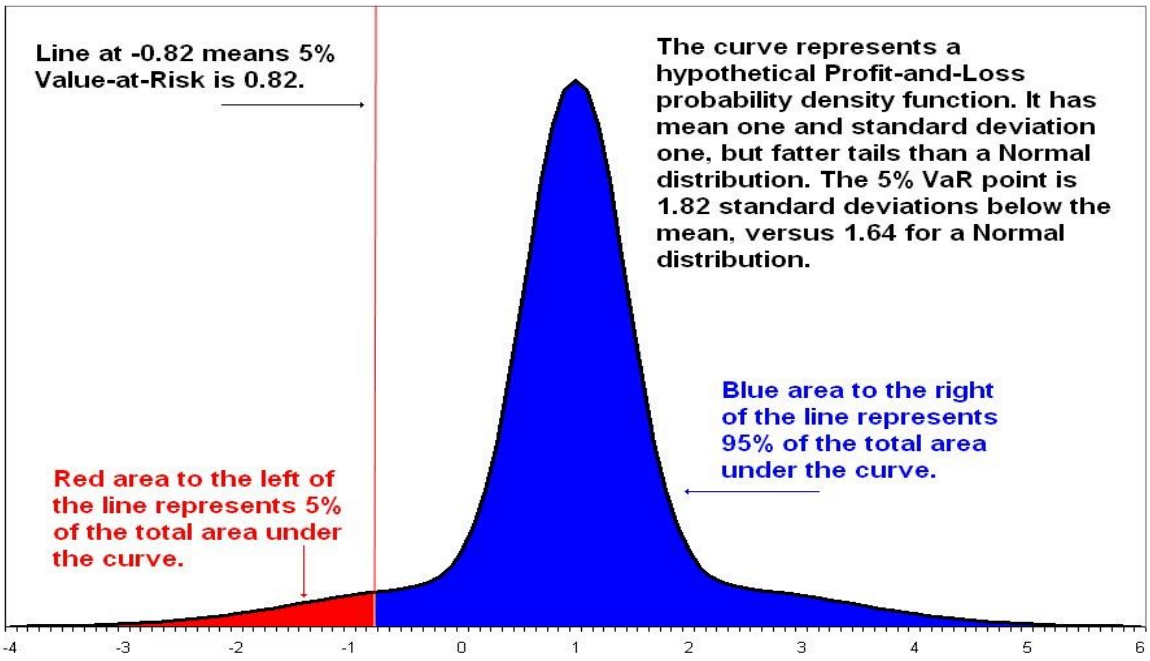
$$\hat{\sigma} = \sqrt{\frac{1}{N} \cdot \sum_{t=1}^{T} \left[L_t - \left(\hat{\alpha} + \hat{\beta} \cdot P_t\right)\right]^2} = \sqrt{\frac{1}{N} \cdot \sum_{t=1}^{T} \varepsilon_t^2}\,, \tag{2.23}$$

where all the variables have been explained above.

2.4 Value at Risk

As we have known, the last step of CorporateMetrics procedure refers to the risk computation. And Value at Risk (VaR) methodology is exactly the most often used by a corporate for estimating the maximum potential loss with a given probability, then it enables the corporate to cover its possible losses according to the amount of assets with the potential loss. Moreover, Value at Risk methodology can also be used for allocating the investment sources, capital requirements determination, financial risk management, etc. And one of the greatest advantages of Value at Risk methodology is that it converts all risks to a common denominator. The following Figure 2.2 shows an example for Value at Risk of a hypothetical profit-and-loss probability density function.

Figure 2.2: Example for Value at Risk of a Hypothetical Profit-and-Loss Probability Density Function



Source: https://www.wikipedia.org

Mathematically, Value at Risk methodology can be defined as a one-sided quantile (for example, 95%) from the distribution of profits and losses of the portfolio for a particular holding period, determined on a historical basis. Correct calculation of Value at Risk requires correct valuation of the entire portfolio in different scenarios. Nevertheless, there exists two drawbacks when applying Value at Risk methodology for measuring risk as well as eliminating risk of potential losses. Due to the fact that it takes into account the correlation between risk categories as well as risk factors. On the other hand, Value at Risk methodology does not take into account the benefits of diversifying different risks in the same portfolio. *"The basic concept for determining VaR is based on the portfolio random profit ($\Delta\tilde{\pi}$) should be lower than a predetermined level (PROFIT) with stated probability α (significance). Thus, the VaR measures the loss and the profit can be formulated as a negative loss. Hence, the idea can be defined as it's indicated below:"*[2]

$$\Pr(\Delta\tilde{\pi} \leq +\text{PROFIT}) = \alpha\,, \tag{2.24}$$

[2] ZMEŠKAL, Z., D. DLUHOŠOVÁ and T. TICHÝ. Financial Models. 1st ed. Ostrava: VSB-Technical University of Ostrava, 2004. ISBN 80-24807548.

where all the variables have been explained above.

In case of the profit is expressed as a negative loss ($PROFIT = -VaR$), the above formula (2.24) can be modified as follows:

$$\Pr(\Delta\tilde{\pi} \leq -\mathrm{VaR}) = \alpha \ , \tag{2.25}$$

where all the variables have been explained above.

The formula (2.24) and (2.25) are key equations for the main concept of VaR.

3. Characterization of Heineken Company

In this chapter, we will describe the characterization of Heineken company from three main aspects: overview of Heineken company, global beer industry analysis and SWOT analysis of Heineken company. After learning about the basic characterization of Heineken company, you will get a better understanding about the Heineken company.

3.1 Overview of Heineken Company

As is said by the Heineken company, "We are a proud, independent and responsible global brewer committed to bringing enjoyment to consumers around the world." Indeed, till today, the Heineken company stands for the number one brewer of the whole Europe and the second greatest brewer around the world. Moreover, Heineken is also famous for its iconic green bottle and red star. These are such distinguishing features that can be differentiate from other beer brands. The following Image 3.1 shows the logo of Heineken.

Image: 3.1 Logo of Heineken

Source: https://www.heineken.com

3.1.1 History of Heineken Company

Standing as one of the oldest breweries around the world, it's necessary for us to learn about the long history of Heineken company. And the history of Heineken company can be traced back to year 1864. In that year, a 22-year-old young Dutch entrepreneur named Gerard

Adriaan Heineken founded his first brewery in the heart of Amsterdam with the financial support by his wealthy mother. Since then, the brewery started to produce the beer with the founders' family name printed on it. Day by day, after the efforts of four generations of the Heineken family, the Heineken company have expanded the Heineken brand and accomplished today's achievement.

Next, we will emphatically introduce three persons who have made a significant contribution to the Heineken company for leading the success of it step by step. We have already introduced Gerard Adriaan Heineken before who created the Heineken company, then, after the retirement of him, the company was passed to his son, Henry Pierre Heineken. He managed the Heineken company from 1917 to 1940. And the eventful contribution that he has made for the company was to improve the techniques of brewing in order to preserve the high quality of Heineken lager.

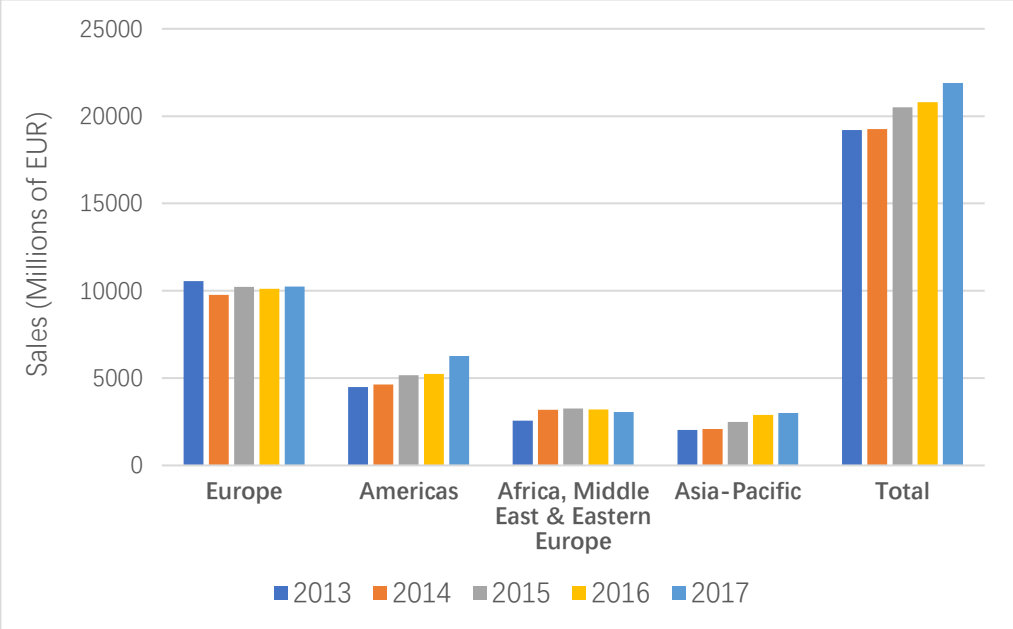
Then, the Heineken company was held by Henry Pierre Heineken's son, Alfred Heineken. He worked from 1940 to 1971 as Chairman of the Executive Board. Just like his father, Alfred Heineken made some great changes to improve the development of the company as well. He devoted to the career of expanding the Heineken company to make it more globally. This huge change made the company take a big step forward without any doubt. In 1968, the company merged with Amstel which was their biggest competitor at that time. And the action of merger also led to the great development of Heineken company.

From 2005 till now, the Jean-François Van Boxmeer is the Chairman of the Board and CEO of the Heineken company. During this period, the Heineken company has made lots of actions of mergers and acquisitions. In 2007, Heineken company acquired two companies, Scottish and Brewer. This acquisition made the Heineken company become the third largest brewer around the world. And in 2010, it made another acquisition of the brewery division of FEMSA. Actually, it's clear that the great success of this company is inseparable from mergers and acquisitions. Till today, the Heineken company has operated business in over 70 markets globally, along with huge portfolio of over 170 beer brands, which makes Heineken company become the most international brewer around the world.

3.1.2 Market Segmentation of Heineken Company

The Heineken company is the most international brewer around the world. It operates business through five market segments: Europe; Americas; Africa, Middle East & Eastern Europe; Asia Pacific. And for each different market, products which are sold will also be different. In order to learn more information of the sales condition for each market segmentation. We will create the Figure 3.1 to better describe the situation from 2013 to 2017.

Figure 3.1: Heineken's Full-Year Sales for Each Market from 2014 to 2017



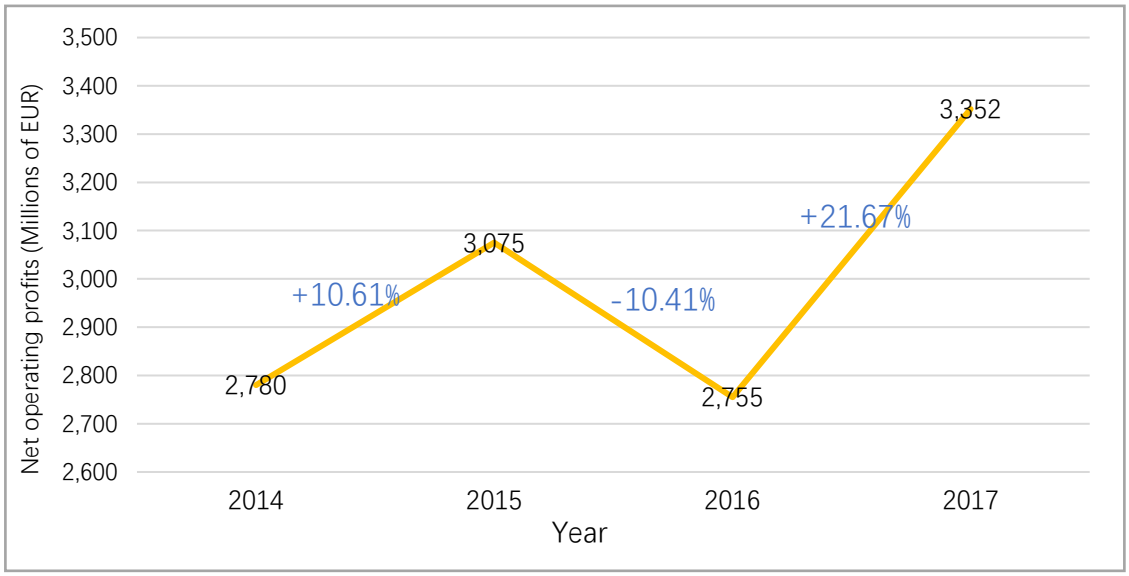
As we can see from the Figure 3.1, the full-year sales for European market always accounted for the highest value among all the markets from 2013 to 2017. It was because that the markets in Europe were quite mature comparing with other markets. Moreover, the brands belonged to the Heineken company that are sold in European market are much more than the brands sold in other markets. The brands sold in Europe include such as such as Heineken, Cruzcampo, Birra Moretti, Zywiec and Strongbow Apple Ciders, etc. Nevertheless, even though the European market accounted for the highest sales among all the markets, we can still see there was a clear decline trend of sales during these years in European market. And the main reason is that in Europe, there indeed exists plenty offerings with premium and high quality. Therefore, it's not easy to further push forward sales from value brands to premium brands in European market. On the contrary, we can clearly see that there were general increasing trends of sales in rest markets: America; Africa, Middle East & Eastern Europe; Asia-Pacific. This

situation was quite understandable due to the increasing demand for beer, and the most important thing is the raising demand for international beer brand. As a result of the high quality of the beer of Heineken company and its own brand effect, strong competencies among the whole beer industry, as well as the increasing inclusiveness of customers for international brands, there is no doubt that the sales in other markets will have such good performance.

3.1.3 Financial Performance of Heineken Company

Due to the fact that we will estimate the net operating profits of Heineken company in 2019 in the chapter 4. Thus, it's necessary for us to describe the basic financial situation of the company's net operating profits before. The following Figure 3.2 shows the net operating profits of Heineken company from 2014 to 2017 and growth rate of each year.

Figure 3.2: Net Operating Profits of Heineken Company and Growth Rate from 2014 to 2017



As is shown in the Figure 3.2, although the net operating profits of Heineken company fluctuated from 2014 to 2017, the general trend of it was increasing during these periods. Especially from 2016 to 2017, there was a huge growth of net operating profits. The success of Heineken company in 2017 benefited from the growth in each market. According to the Figure 3.1 in above subchapter, the sales for each market indeed pulled up the total sales for the whole company. In particular, the performance in American market made a great contribution for the total sales. As we have mentioned that the products sold for each different market will also be different. Therefore, the great performance in American market was owing to some new alcohol-free products only launched in American market. In addition, the strength of the U.S.

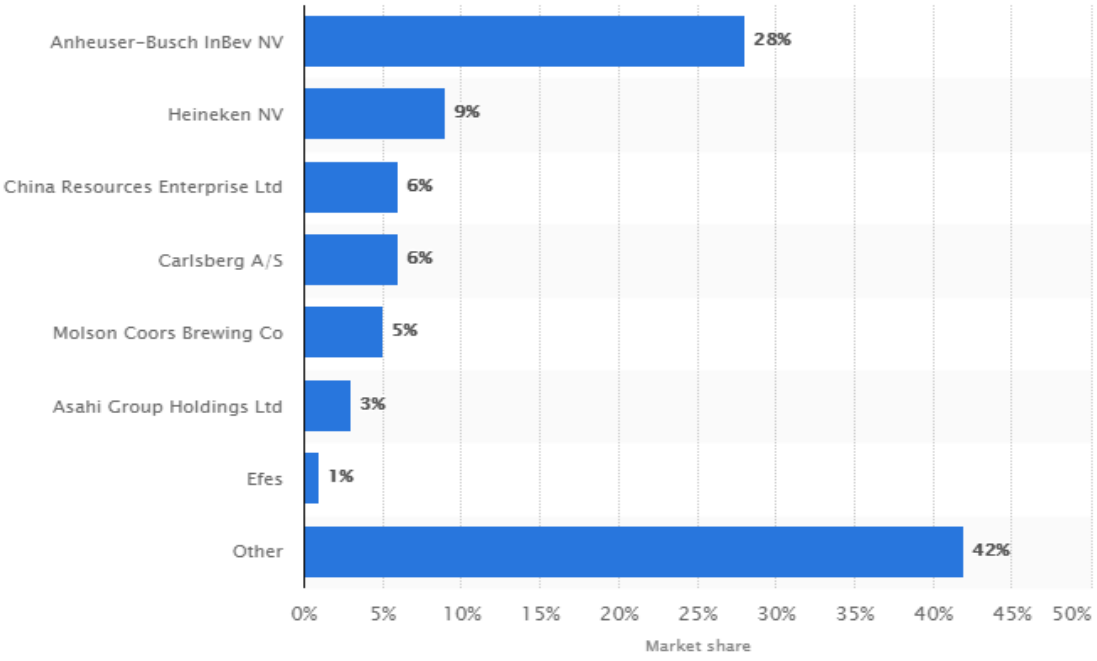
dollar for euro during that period also make a contribution for the huge growth of net operating profits. Nevertheless, in order to find out what the trend of net operating profits for Heineken company will be in 2019, we still need to apply CorporateMetrics methodology for it to get the estimated results. And the results will be seen in chapter 4.

3.2 Global Beer Industry Analysis

As we have known, beer is the oldest and one of the most popular alcoholic beverages around the world. Therefore, the beer industry indeed has a wide range of consumption basis of the market in the world. In recent years, the consumption of beer has increased due to increased disposable income and rising consumer preference for beer over other alcoholic beverages. In addition, the adoption and inclusiveness of western culture also further stimulate the consumption orientation of beer for other countries. However, the extensive government regulations for the beer industry and high excise taxation and duties levied on alcohol are also unfavorable for the beer industry. But in general, in near future, there will still offer numerous growth opportunities for the beer industry.

Then, we will introduce the situation of market share of leading beer companies among the whole beer industry. The results will be seen in the Figure 3.3.

Figure 3.3: Global Market Share of Leading Beer Companies in 2016, Based on Volume Sales



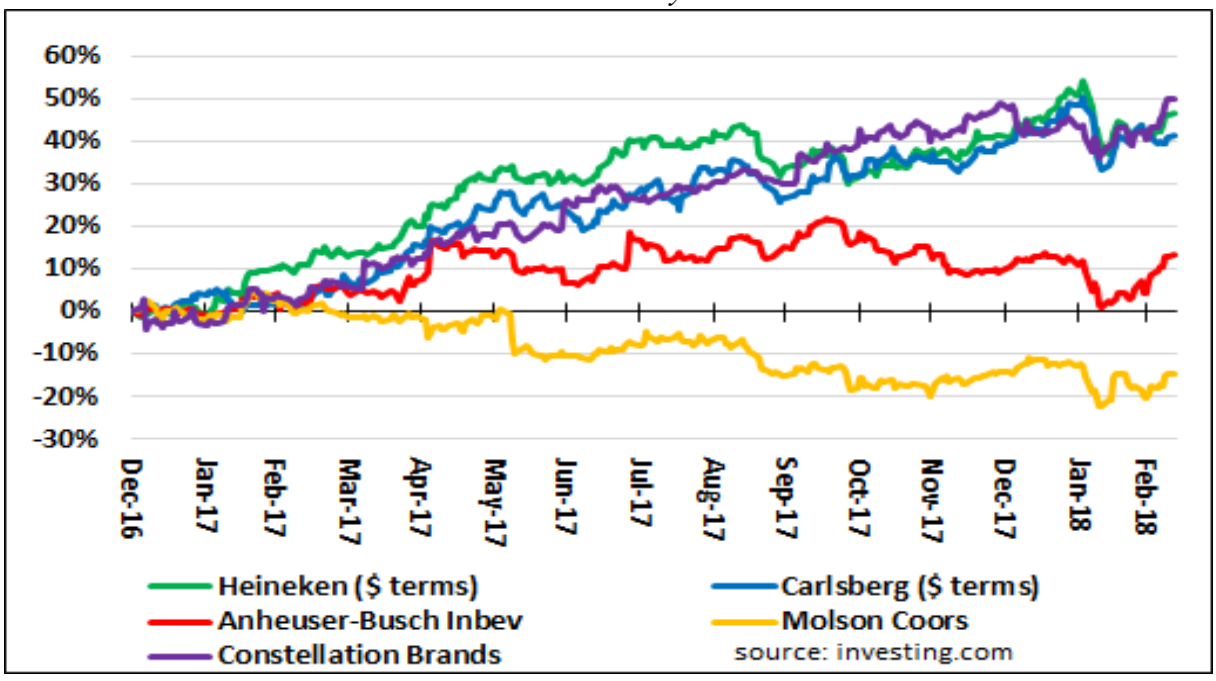
Source: https://www.statista.com

As is shown in the Figure 3.3, we can see that the market shares of all of these seven leading beer companies accounted for more than 50% of the whole market, while other beer companies only accounted for 42%. Wherein the market share of one of leading companies — the Heineken company accounted for the global market was about 9% in 2016 which was the second highest, just behind the Anheuser-Busch InBev NV in the beer industry. And it was clear that the result was quite good. Because it indicated that the Heineken company played an important role in the whole beer industry. Nevertheless, although the market share of Heineken company was the second highest in the beer industry, it was still much lower than the number one Anheuser-Busch InBev NV. The main reason was that in 2016, the merger of two big beer companies — ABinBev and SABMiller created the new beer company, the Anheuser-Busch InBev NV. Therefore, the Anheuser-Busch InBev NV has very strong competitive strength.

Actually, as the result of the long industrial chain, complex channel system and terminal system, the beer industry needs lots of the activities of mergers and acquisitions from the multi-layer relationship between producers; producers and channels; producers and terminals.

Next, we will then analyze the beer industry from the stock market. Which means that we will introduce the percentage change of shares of five leading beer companies from December 2016 to February 2018. The results will be seen in the Figure 3.4.

Figure 3.4: Percentage Change of Shares of Five Leading Beer Companies from December 2016 to February 2018



Source: https://www.investing.com/

As is shown in the Figure 3.4, we can see that the performance of these five leading companies in the stock market can be divided into two camps. The first camp includes the Heineken, Carlsberg and Constellation Brands. They have had very well performance during these periods. There were clear rising trends among these companies' stocks. Another camp includes Anheuser-Busch InBev and Molson Coors. On the contrary, they haven't performed that well. For the Heineken company, the good performance benefitted from the strength of euro. As we have mentioned, the Europe market accounted for the highest value among all of its markets. Therefore, the strength of euro was the main reason that stimulate the Heineken company's stock. In contrast, the general trend of percentage change of shares for Anheuser-Busch InBev was declining. We can see that although Anheuser-Busch InBev accounted for the largest market share among the global market, its performance in stock market faced a variety of problems. What has caused this situation might be those activities of transformative acquisitions.

3.3 SWOT Analysis of Heineken Company

Through the introduction of above two subchapters, we have introduced many information about the Heineken company. In order to have more concrete knowledge of Heineken company, and better understanding for the specific position of it as a whole, it's necessary to conduct SWOT analysis for the company. The SWOT analysis is used to assess a company's competitive position and develop strategic planning. It contains four parts: strengths, weakness, opportunities and threats. The strengths and weakness concern the internal factors of the company, as well as the current potential. On the contrary, the opportunities and threats concern the external factors, as well as the future potential.

3.3.1 Strengths of Heineken Company

The strengths of Heineken company will be summarized as follows:

- ***High quality of products***

The quality of Heineken company's products is really high. Moreover, for the long time, Heineken company can always maintain its high quality. Therefore, the products are valued by its customers.

- ***Strong brand portfolio — differentiated products for different markets***

As we have mentioned before, Heineken company operates business through five market segments. And for each different market, products which are sold will also be different. This character makes Heineken company acquire stable revenue inflows under such strong brand portfolio. Nevertheless, the brand Heineken is sold in every market.

- ***Strong network of breweries***

The Heineken company has a widespread network of breweries which located very close to its each end market. Therefore, it's very convenient for Heineken company to serve its customers with fresh beer, as well as low costs. This character can really keep the satisfaction of its customers and maintain long and steady relationship with its customers.

- ***Strong brands effect***

Although Heineken company supply differentiated products for different markets, there is still only one brand which is sold in every market, that is Heineken. It is because that Heineken company always focus on the international brand Heineken through all the advertising, promoting and sponsorship activities, which makes Heineken company owns a high awareness brand and very strong brand effect.

- ***Strong strategic partnership***

The Heineken company has established a very strong partnership with its suppliers, retailers, and dealers. Which provides Heineken company an easier way for communication, promoting and selling its products.

3.3.2 Weakness of Heineken Company

The weakness of Heineken company will be summarized as follows:

- ***Vertical Integration***

The Heineken company operates lots of activities of mergers, nevertheless, they are aimed at vertical integration, which has conflicts with its current structure and situation. Thus, it often causes the failure of the activities of mergers. In order to improve the condition, Heineken company needs to adjust its strategy of integration according to its own structure.

- ***Relatively high price***

As we have mentioned, the quality of Heineken products is really good, and Heineken

company brew its beer only with pure, natural ingredients. Which makes the costs for brewing beer expensive. Therefore, the price for Heineken is slightly higher than its competitors of beer industry.

- ***Too much reliance on a few products***

As we have mentioned before that the Heineken company really focus on the brand Heineken, and the brand Heineken indeed has high market share. While other lots of brands only accounted for very small market share. Too much reliance on the brand Heineken will strike the company if something bad happen to the brand Heineken.

3.3.3 Opportunities of Heineken Company

The opportunities of Heineken company will be summarized as follows:

- ***Development of technology***

As the technology develops, it enables the improvement for the operations of brewing, which can make the costs further reduce. Moreover, it can also further improve the quality of the products.

- ***Improvement of E-commerce***

In addition to the development of technology, the improvement of E-commerce also creates more channels for Heineken company to sell its products. Especially the online store can further increase the sales of its products.

- ***Development of microbreweries***

Nowadays, as the development of microbreweries, it provides a new brewing mode for Heineken company, which means that it can have more opportunities to acquire its own small breweries chain business.

- ***Positive trends of drinking beer***

With the growth of economy, people's living standards continue to improve. Moreover, the tolerance for beer outside the western region also continue to be increasing. Which makes the trend of drinking beer become more and more popular.

3.3.4 Threats of Heineken Company

The threats of Heineken company will be summarized as follows:

- ***Fierce competition***

As we have mentioned before, the market share of Heineken company was the second highest in the beer industry, it was still much lower than the number one Anheuser-Busch InBev NV. The Anheuser-Busch InBev NV indeed has very strong competitive strength, it can be seen as the largest and most threatening competitor for the Heineken company.

- ***Fluctuation of exchange rate***

As a result of being an international company, there is no doubt that Heineken company will face the risk of fluctuation of exchange rate, while its source of suppliers come from local market, and sales come from global.

- ***Strict tax regulation***

The tax regulation for the beer industry is very strict. The Heineken company will be under great pressure of the strict taxation levied on alcohol.

- ***Legal barriers***

For the beer industry, there is still a lack of government support, as well as much legal barriers especially exported in foreign markets. Under such environment, it's really hard for the future development of beer industry.

4. CorporateMetrics Methodology Application in the Selected Company

In this chapter, we will apply CorporateMetrics methodology to our selected company, Heineken company. In order to estimate the net operating profits of Heineken company in 2019 under some risks which the company will undertake.

4.1 Prediction of Market Exchange Rate

Due to the fact that Heineken company operates export business to several regions outside of Netherlands, it will face the exchange rate risk. These regions include the Europe, America, Africa and Asia Pacific. Considering that there are too many kinds of currencies, we will make a simplification that for the region Europe and Africa, Heineken company will only accept euro when it exports goods, for the region America, Heineken company will only accept dollar when it exports goods, and for the region Asia Pacific, Heineken company will only accept yuan when it exports goods. Moreover, as a result that the raw materials which Heineken company uses for production are from the local farms and pharmacies of Netherland, there will be no exchange rate risk or commodity risk with regard to import business. After determining the currencies, we will predict the market exchange risk refers to EUR/USD and EUR/CNY.

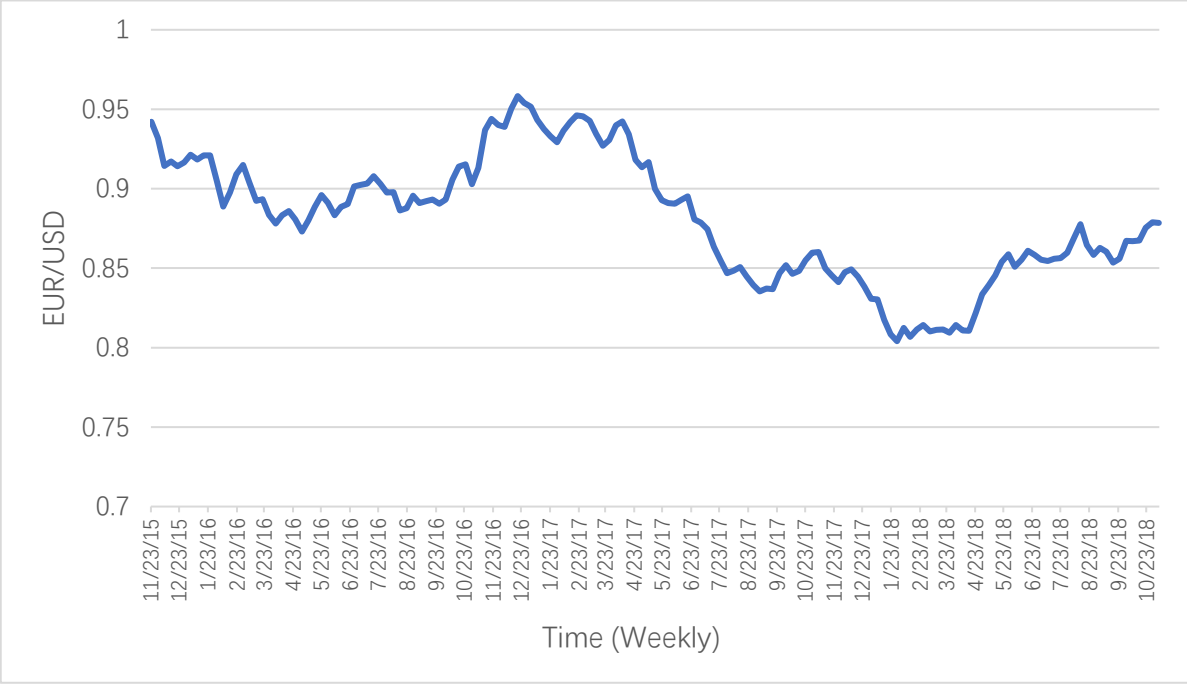
4.1.1 Exchange Rate of EUR/USD Prediction

The procedure of prediction for exchange rate of EUR/USD concerns two main steps. The first step is to analyze the history trend of exchange rate of EUR/USD, and the second step is to conduct the simulation of the random evolution of EUR/USD.

4.1.1.1 History Trend of Exchange Rate of EUR/USD

In our thesis, we select weekly data from 23rd November 2015 to 5th November 2018 as the historical data for analyzing the trend. The following Figure 4.1 shows the trend of weekly exchange rate of EUR/USD from our selected period.

Figure 4.1: Weekly Exchange Rate EUR/USD from 23rd November 2015 to 5th November 2018



As we can clearly see from the Figure 4.1 that the general trend of exchange rate of EUR/USD was decreasing from 23rd November 2015 to 5th November 2018. So, we will apply the geometric Brownian motion to predict the exchange rate of EUR/USD.

By using the formula (2.12) and (2.13) which we have mentioned in chapter 2, we can get the results of mean value (α), standard deviation (σ), interval (Δt) and initial exchange rate (E_0). The results are shown in the following Table 4.1.

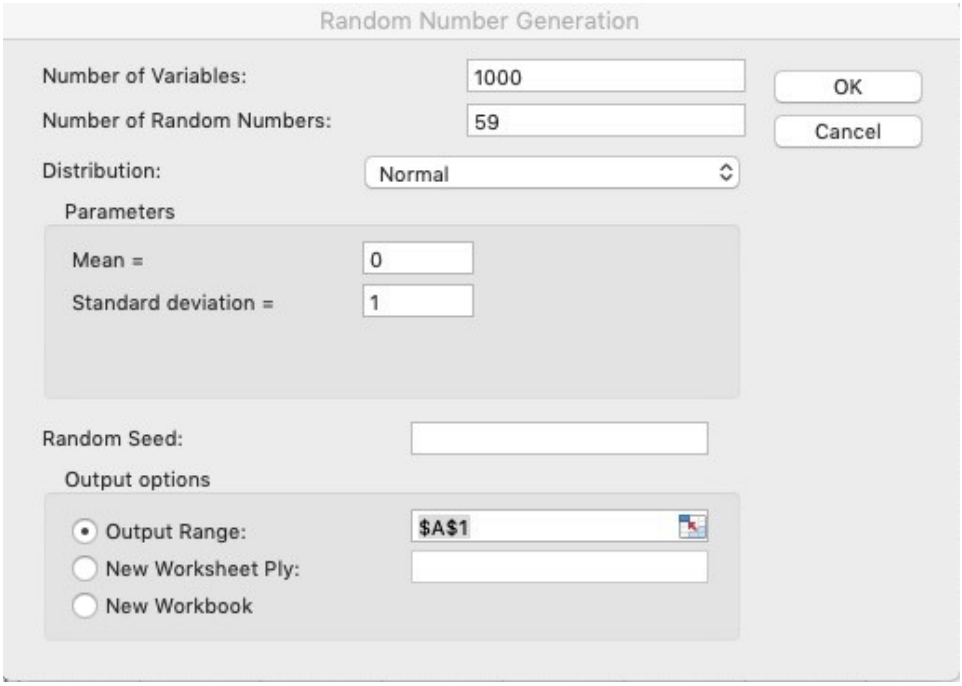
Table 4.1: Parameters for Simulating the Random Evolution of EUR/USD

α	σ	Δt	E_0
-0.0487%	0.8017%	1	0.8784

4.1.1.2 Simulation of the Random Evolution of Exchange Rate of EUR/USD

This step refers to firstly use Random Number Generation in Excel to generate random numbers ($\tilde{z}$) which include 1000 scenarios, and for each scenario will have 59 numbers with standard normal distribution. The reason why we need to generate 59 numbers is that there are 52 weeks during the year 2019, and due to the initial exchange rate of EUR/USD we get is from 5th November 2018, there are still 7 weeks from 5th November 2018 to the end of 2018. Thus, finally we need to generate 59 numbers in total in order to predict the exchange rate in 2019. The following Figure 4.2 shows the procedure of generating random numbers in Excel.

Figure 4.2: Random Number Generation for Standard Normal Distribution

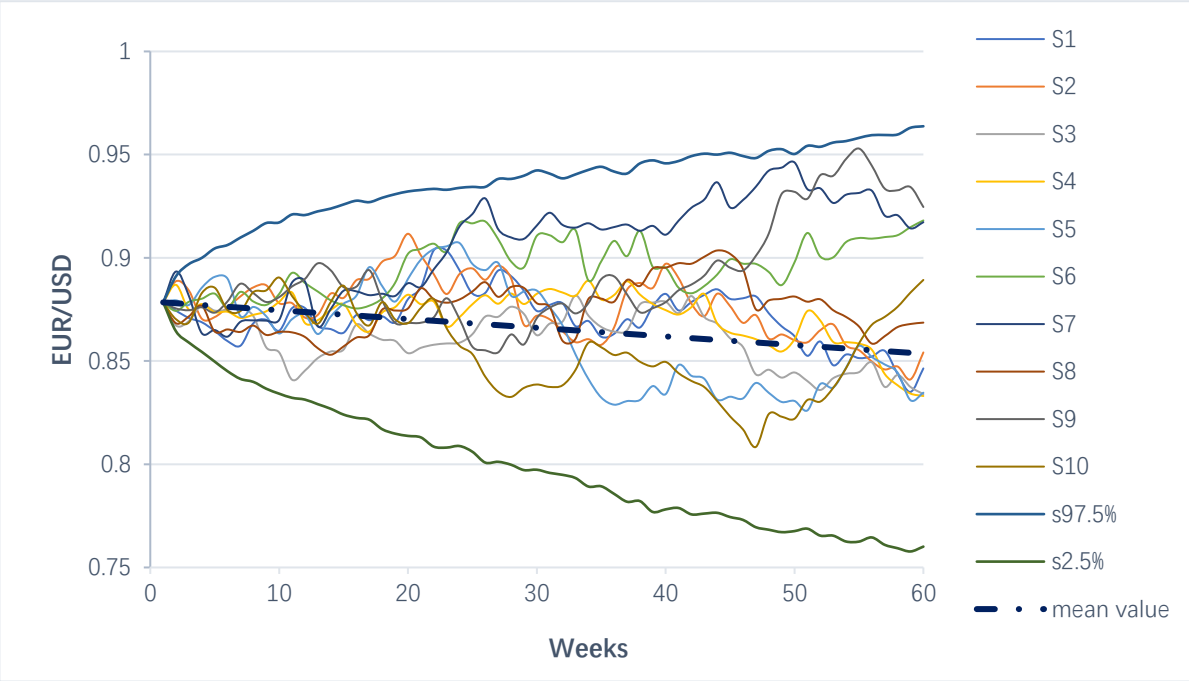


After generating random number for standard normal distribution, we will put the data of parameters from Table 4.1 and random numbers ($\tilde{z}$) into formula (2.14) that we have mentioned in chapter 2. Then, we will get the final results. And the final results can be expressed in Table 4.2 and in Figure 4.3 graphically.

Table 4.2: 10 Scenarios Samples of Random Exchange Rate Evolution of EUR/USD for 59 Weeks

	W0	W1	W2	W3	…	W57	W58	W59
S1	0.878	0.874	0.871	0.869	…	0.844	0.835	0.846
S2	0.878	0.889	0.884	0.871	…	0.847	0.841	0.854
S3	0.878	0.867	0.869	0.877	…	0.843	0.837	0.834
S4	0.878	0.887	0.875	0.878	…	0.838	0.834	0.833
S5	0.878	0.879	0.877	0.886	…	0.844	0.831	0.835
S6	0.878	0.874	0.879	0.880	…	0.911	0.915	0.918
S7	0.878	0.893	0.881	0.863	…	0.921	0.914	0.917
S8	0.878	0.868	0.872	0.877	…	0.866	0.868	0.869
S9	0.878	0.875	0.875	0.876	…	0.933	0.934	0.925
S10	0.878	0.870	0.869	0.883	…	0.876	0.883	0.889
s97.5%	0.878	0.891	0.897	0.900	…	0.960	0.963	0.964
s2.5%	0.878	0.864	0.859	0.854	…	0.759	0.758	0.760
mean value	0.878	0.878	0.878	0.877	…	0.854	0.854	0.854

Figure 4.3: 10 Scenarios Samples of Random Exchange Rate Evolution of EUR/USD for 59 Weeks



As we can see from the Figure 4.3 that the 10 chosen samples from the1000 scenarios are in the range of 2.5% coefficient percentile and 97.5% coefficient percentile. Some scenarios show the upward trend. However, some scenarios present the downward trend. But the trend of the mean value of these 1000 scenarios of exchange rate is decreasing. Thus, in general, the trend of the prediction of exchange rate EUR/USD is declining for the year 2019. It also indicates that we estimate in 2019, the dollar has a tendency of depreciation. On the contrary, the euro has a tendency to appreciate.

4.1.2 Exchange Rate of EUR/CNY Prediction

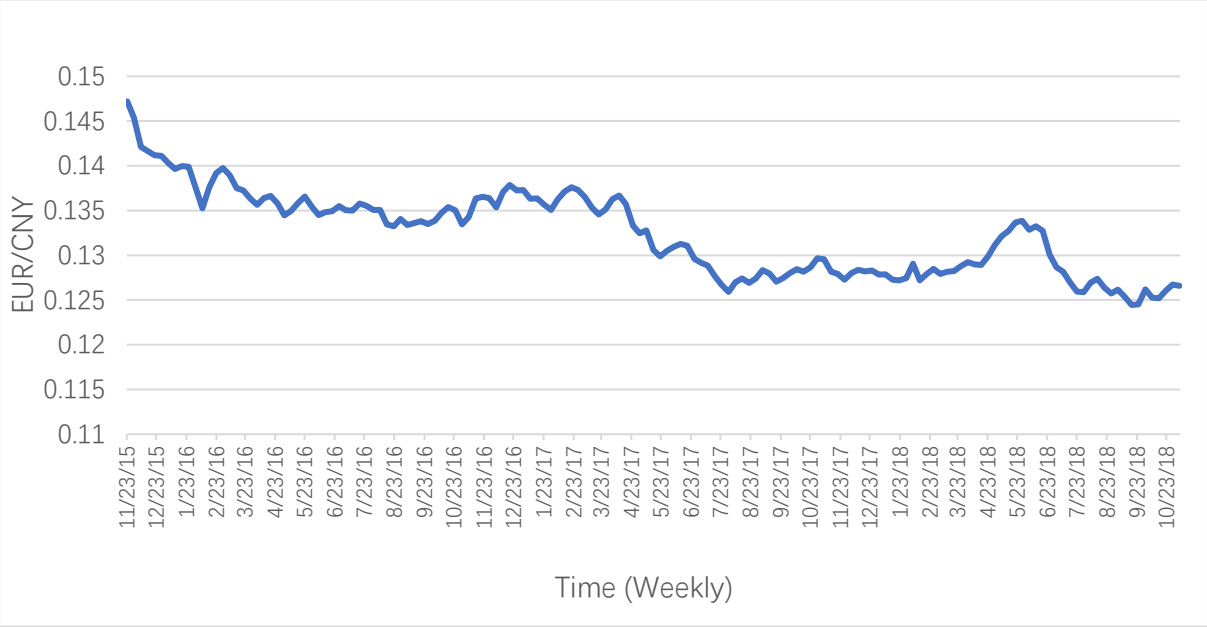
Similar to the prediction of exchange rate of EUR/USD, the procedure of prediction for exchange rate of EUR/CNY also concerns two main steps. The first step is to analyze the history trend of exchange rate of EUR/CNY, and the second step is to conduct the simulation of the random evolution of EUR/CNY.

4.1.2.1 History Trend of Exchange Rate of EUR/RMB

Similarly, when we analyze the history trend of exchange rate of EUR/CNY, we also select weekly data from 23rd November 2015 to 5th November 2018 as the historical data. The

following Figure 4.4 shows the trend of weekly exchange rate of EUR/CNY from our selected period.

Figure 4.4: Weekly Exchange Rate EUR/CNY from 23rd November 2015 to 5th November 2018



As we can clearly see from the Figure 4.4 that the general trend of exchange rate of EUR/CNY was decreasing from 23rd November 2015 to 5th November 2018. So, we will apply the geometric Brownian motion to predict the exchange rate of EUR/CNY as well.

By using the formula (2.12) and (2.13) which we have mentioned in chapter 2, we can get the results of mean value (α), standard deviation (σ), interval (Δt) and initial exchange rate (E_0). The results are shown in the following Table 4.3.

Table 4.3: Parameters for Simulating the Random Evolution of EUR/CNY

α	σ	Δt	E_0
-0.1005%	0.7038%	1	0.1266

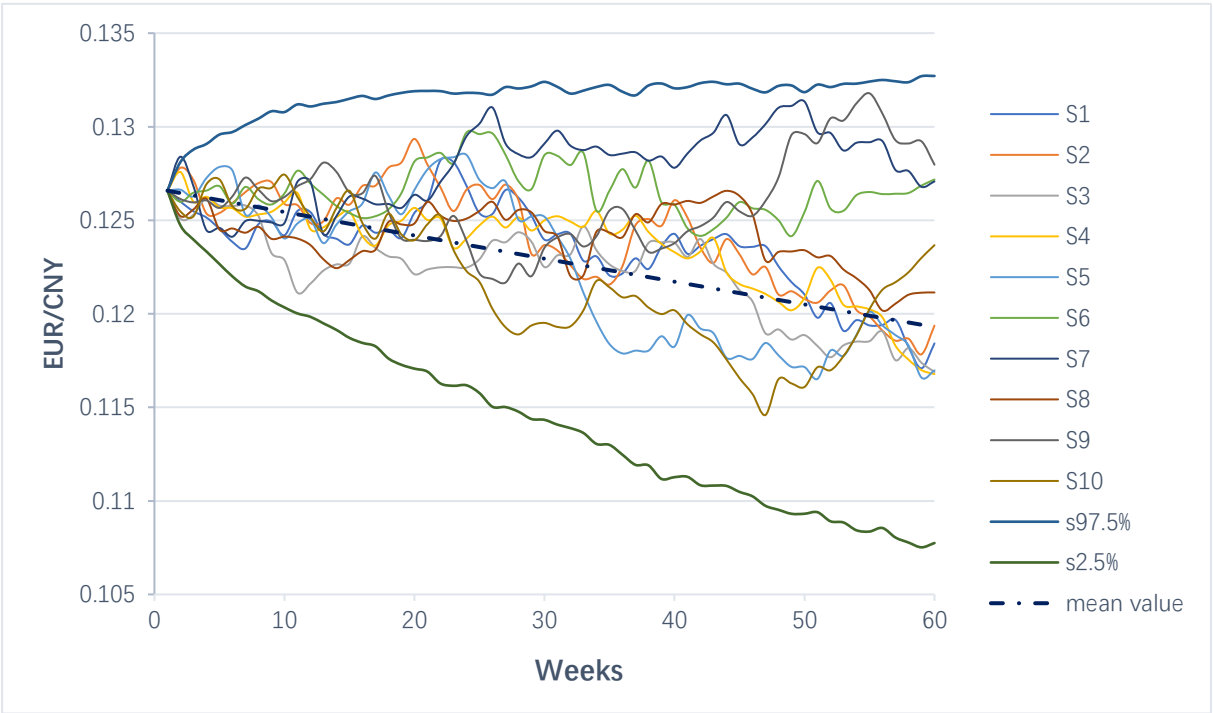
4.1.2.2 Simulation of the Random Evolution of Exchange Rate of EUR/USD

As well as the procedure for the simulation of the random evolution of exchange rate of EUR/USD, we also need to generate 1000 scenarios random numbers ($\tilde{z}$) with standard normal distribution and then put the data of parameters from Table 4.3 and random numbers ($\tilde{z}$) into formula (2.14) that we have mentioned in chapter 2. Eventually, we will get the final results. And the final results can be expressed in Table 4.4 and graphically in Figure 4.5.

Table 4.4: 10 Scenarios Samples of Random Exchange Rate Evolution of EUR/CNY for 59 Weeks

	W0	W1	W2	W3	…	W57	W58	W59
S1	0.127	0.126	0.125	0.125	…	0.118	0.117	0.118
S2	0.127	0.128	0.127	0.125	…	0.119	0.118	0.119
S3	0.127	0.125	0.125	0.126	…	0.118	0.117	0.117
S4	0.127	0.128	0.126	0.126	…	0.118	0.117	0.117
S5	0.127	0.127	0.126	0.127	…	0.118	0.117	0.117
S6	0.127	0.126	0.126	0.127	…	0.126	0.127	0.127
S7	0.127	0.128	0.127	0.124	…	0.128	0.127	0.127
S8	0.127	0.125	0.126	0.126	…	0.121	0.121	0.121
S9	0.127	0.126	0.126	0.126	…	0.129	0.129	0.128
S10	0.127	0.125	0.125	0.127	…	0.122	0.123	0.124
s97.5%	0.127	0.128	0.129	0.129	…	0.132	0.133	0.133
s2.5%	0.127	0.125	0.124	0.123	…	0.108	0.108	0.108
mean value	0.127	0.126	0.126	0.126	…	0.120	0.119	0.119

Figure 4.5: 10 Scenarios Samples of Random Exchange Rate Evolution of EUR/CNY for 59 Weeks



As we can see from the Figure 4.5 that the 10 chosen samples from the1000 scenarios are in the range of 2.5% coefficient percentile and 97.5% coefficient percentile. Correspondingly, some scenarios show the upward trend, others present the downward trend. But the trend of the mean value of these 1000 scenarios of exchange rate is decreasing. Thus, in general, the trend of the prediction of exchange rate EUR/CNY is also declining for the year 2019. It also indicates that we estimate in 2019, the Chinese yuan has a tendency of depreciation. On the contrary, the euro has a tendency to appreciate.

4.2 Prediction of Demand

In addition to the exchange rate risk, Heineken company will also face the risk of change of demand. The demand can be reflected by the consolidated beer volume. In other word, we will also predict the consolidated beer volume that will be sold for estimating the net operating profits of Heineken company in 2019.

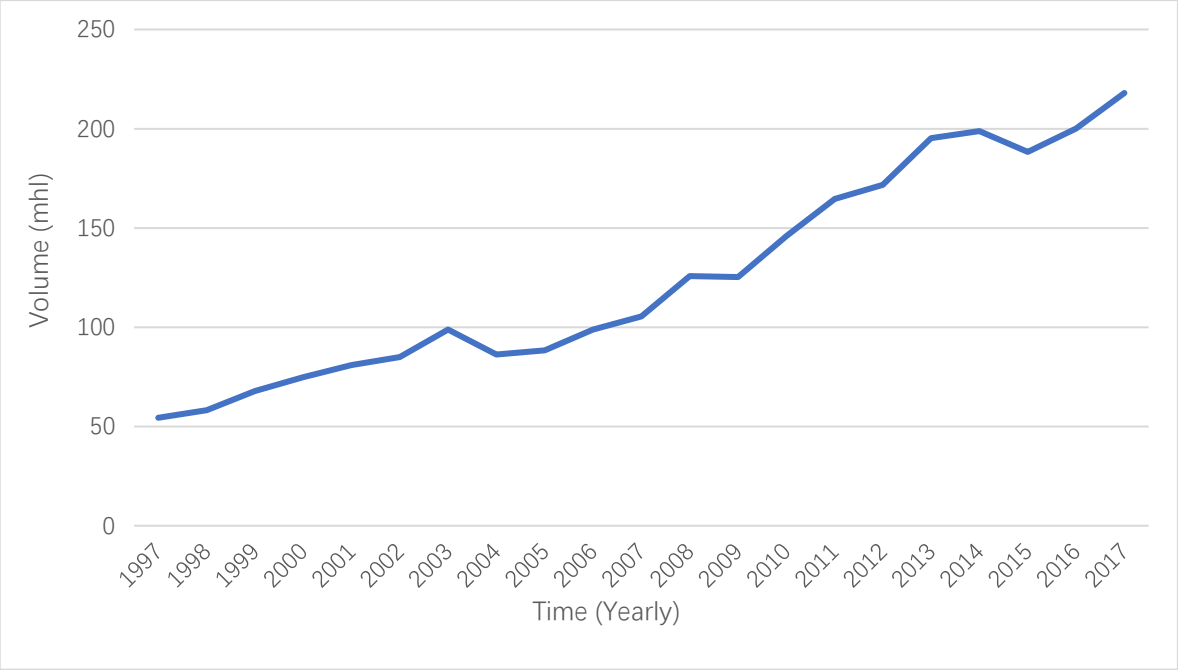
4.2.1 Consolidated Beer Volume Prediction

Similar to the market exchange rate, the procedure of prediction for consolidated beer volume also concerns two main steps. The first step is to analyze the history trend of consolidated beer volume, and the second step is to conduct the simulation of the random evolution of consolidated beer volume.

4.2.1.1 History Trend of Consolidated Beer Volume

For analyzing the history trend, differ from the market exchange rate, we will select yearly data instead of weekly data from the Heineken annual report during the period between 1997 to 2017 as the historical data. The following Figure 4.6 shows the trend of yearly consolidated beer volume from our selected period.

Figure 4.6: Yearly Consolidated Beer Volume from 1997 to 2017



As is shown in the Figure 4.6, we can see that the general history trend of consolidated beer volume was increasing from 1997 to 2017. It also represented the rising trend of demand. So, we will apply the geometric Brownian motion to predict the consolidated beer volume in 2019 as well.

By using the formula (2.12) and (2.13) which we have mentioned in chapter 2, we can get the results of mean value (α), standard deviation (σ), interval (Δt) and initial consolidated beer volume (V_0). The results are shown in the following Table 4.5.

Table 4.5: Parameters for Simulating the Random Evolution of Consolidated Beer Volume

α	σ	Δt	V_0
6.6494%	7.6326%	0.25	58.3

Now the Δt becomes 0.25 instead of 1, it is because that the data we have selected for analyzing the history trend is yearly data, nevertheless, we will make a prediction for each quarter of year 2019. Thus, we need to divide 1 by 4, and then get 0.25.

Moreover, what also needs to be noted here is that the initial consolidated beer volume (V_0) represents the last quarter of year 2018. And it was a predicted value which was calculated. The procedure is as follows:

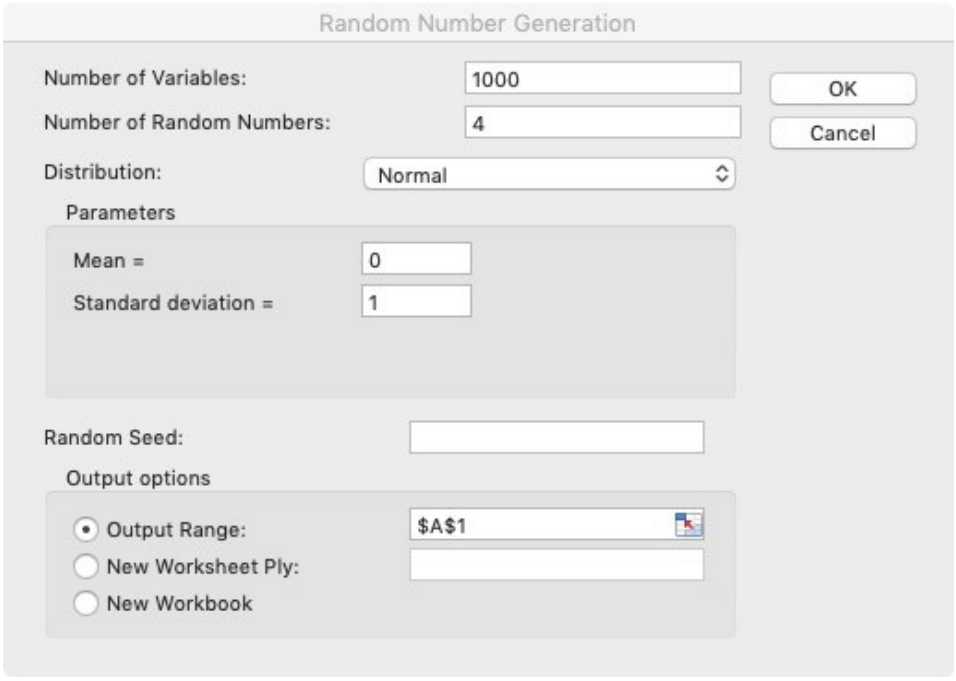
$$V_0 = \frac{V_{2017} \cdot (1+\mu)}{4}, \tag{4.1}$$

where V_{2017} represents the consolidated beer volume of the whole year 2017, μ represents the average continuous return during the period from 1997 to 2017, which we have mentioned in chapter 2. Thus, $V_{2017} \cdot (1 + \mu)$ represents the result of consolidated beer volume of the whole year 2018, and we assume that in 2018, consolidated beer volume for each quarter will be the same, eventually, after $V_{2017} \cdot (1 + \mu)$ divided by 4, we will get the result of consolidated beer volume for last quarter of year 2018.

4.2.1.2 Simulation of the Random Evolution of Consolidated Beer Volume

Similar to the procedure of simulation of the random evolution of market exchange rate, this step also refers to firstly use Random Number Generation in Excel to generate random numbers ($\tilde{z}$) which include 1000 scenarios, but what is different from the procedure for market exchange rate is that for each scenario will have 4 numbers with standard normal distribution. The number 4 represents 4 quarters during the year 2019. The following Figure 4.7 shows the procedure of generating random numbers in Excel.

Figure 4.7: Random Number Generation for Standard Normal Distribution

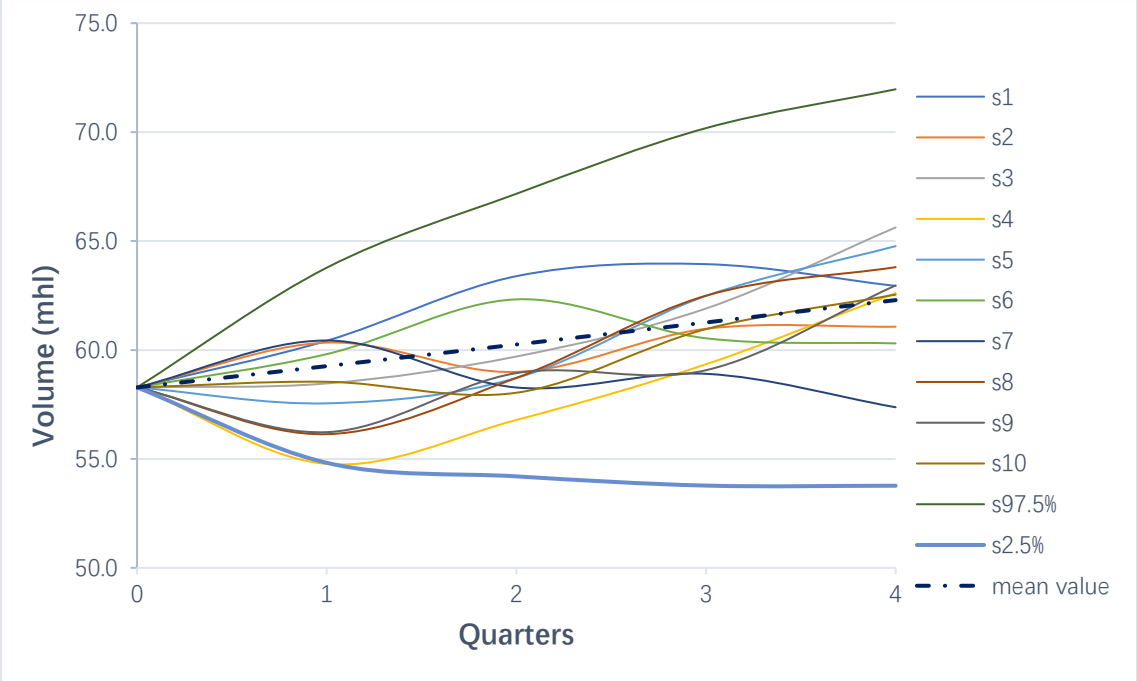


After generating random number for standard normal distribution, we will put the data of parameters from Table 4.3 and random numbers ($\tilde{z}$) into formula (2.14) that we have mentioned in chapter 2. Then, we will get the final results. And the final results can be expressed in Table 4.6 and graphically in Figure 4.8.

Table 4.6: 10 Scenarios Samples of Random Consolidated Beer Volume Evolution for 4 Quarters (mhl)

	Q0	Q1	Q2	Q3	Q4
s1	58.283	60.424	63.388	63.940	62.939
s2	58.283	60.338	58.993	60.973	61.067
s3	58.283	58.465	59.701	61.904	65.626
s4	58.283	54.770	56.789	59.346	62.612
s5	58.283	57.552	58.715	62.481	64.767
s6	58.283	59.811	62.323	60.537	60.303
s7	58.283	60.436	58.277	58.907	57.372
s8	58.283	56.136	58.720	62.493	63.801
s9	58.283	56.229	58.938	59.073	62.963
s10	58.283	58.541	58.037	60.958	62.542
s97.5%	58.283	63.776	67.169	70.184	71.967
s2.5%	58.283	54.823	54.200	53.776	53.770
mean value	58.283	59.260	60.253	61.263	62.290

Figure 4.8: 10 Scenarios Samples of Random Consolidated Beer Volume Evolution for 4 Quarters



As we can see from the Figure 4.8 that the 10 chosen samples from the1000 scenarios are

in the range of 2.5% coefficient percentile and 97.5% coefficient percentile. Correspondingly, nearly all the scenarios show the upward trend. Besides, the trend of the mean value of these 1000 scenarios of exchange rate is also increasing. Thus, in general, the trend of the prediction of consolidated beer volume is rising for the year 2019. It also indicates that we estimate in 2019, the demand for the products of Heineken company will be increasing.

4.3 Prediction of Operating Revenues

As we have mentioned at the start of the chapter, the main goal is to estimate the net operating profits of Heineken company in 2019 by applying CorporateMetrics methodology. So, in order to estimate the net operating profits, we need to estimate the operating revenues and the operating costs first. Finally, the difference between operating revenues and operating costs are the net operating profits. In this subchapter, we will focus on prediction of operating revenues. And the procedures are shown as follows.

4.3.1 Prediction of Average Price

The formula of calculating operating revenues can be written as follows:

$$OR_t = AP_t \cdot TV_t \ , \tag{4.2}$$

where OR_t represents the operating revenues in time t, AP_t represents average price in time t and TV_t represents total volume in time t.

In chapter 4.2, we have gotten the results of prediction of beer volume. According to the formula (4.2), next we will make a prediction of average price, and then we will get the final results of operating revenues by multiplying these two numbers. Nevertheless, what needs to be noticed is that the Heineken company operates export business to several regions outside of Netherlands, thus when we estimate the operating revenues of Heineken company, we will calculate the average price for each region with its own currency, as well as the weight of volume sold in each region accounts for the whole volume sold around the world.

4.3.1.1 Prediction of Average Price in Euro

Firstly, we will predict the total operating revenues and total volume sold in 2019 by using the average growth rate k. The formula can be written as follows:

$$k = \frac{\sum_{t=1}^{T} \frac{S_t - S_{t-1}}{S_{t-1}}}{T}\ , \tag{4.3}$$

$$S_t = S_{t-1} \cdot (1 + k)\ , \tag{4.4}$$

where k represents the average growth rate, S_t and S_{t-1} represents the value in history time period t and t-1.

The following Table 4.7 and Table 4.8 shows the final results of total operating revenues and total volume sold in 2019.

Table 4.7: Prediction of Total Operating Revenues in 2019

	Operating Revenues in Millions of Euro	k
2014	19257	
2015	20511	0.065
2016	20792	0.014
2017	21888	0.053
Average		0.044
2018	22848	
2019	23849	

As is shown in the Table 4.7 that the estimate total operating revenues in 2019 will be 23849 in millions of euro.

Table 4.8: Prediction of Total Volume Sold in 2019

	Volume Sold in mhl	k
2014	198.8	
2015	188.3	-0.053
2016	200.1	0.063
2017	218.0	0.089
Average		0.033
2018	225.2	
2019	232.7	

As is shown in the Table 4.8 that the estimate total volume sold in 2019 will be 232.7 in mhl.

After getting the results of both total operating revenues and total volume sold in 2019,

we will calculate the value of average price in 2019. The results are shown in the following Table 4.9.

Table 4.9: Prediction of Average Price in 2019

Operating Revenues (million euro)	Volume Sold (mhl)	Average Price (million EUR/mhl)
23849	232.7	102.5

We can see from the Table 4.9 that the average price in 2019 will be 102.5 million EUR/mhl.

4.3.1.2 Prediction of Average Price in Foreign Currencies

After estimating the average price in euro, we will make a prediction of average price in foreign currencies which include American dollars and Chinese yuan. The procedures are presented as follows.

Firstly, we will estimate the average exchange rate of EUR/USD and EUR/CNY during the year 2018 separately, we assume that the average exchange rate of EUR/USD and EUR/CNY during the year 2018 will be same or very close to which in 2019. And the following Table 4.10 shows the final results.

Table 4.10: Average Exchange Rate of Foreign Currency in 2019

	EUR/USD	EUR/CNY
Average exchange rate	0.887	0.131

Then, we will calculate the average price in foreign currencies by using the following formula (4.5).

$$AP_F = \frac{AP_D}{E_{D/F}}, \tag{4.5}$$

where AP_F represents average price in foreign currency, AP_D represents average price in domestic currency and $E_{D/F}$ represents the exchange rate.

After applying the formula (4.5), we can get the results of average price in foreign currencies, and the results will be shown in the following Table 4.11.

Table 4.11: Average Price of Foreign Currency in 2019 (million currency/ mhl)

	USD	CNY
Average price	115.6	781.8

4.3.2 Prediction of Weights for Each Region

After predicting the average price for each foreign currency, we will estimate the weights for each region accounting for the total volume sold. The following Table 4.12 shows the volume sold in each region, and the Table 4.13 shows the prediction of weights for each region accounting for the total volume sold in 2019.

Table 4.12: Volume Sold in Each Region from 2014 to 2017 (mhl)

	Volume Sold in Europe	Volume Sold in America	Volume Sold in Asia Pacific	Sum
2014	117.8	57.0	24.0	198.8
2015	112.5	56.0	19.8	188.3
2016	117.0	58.7	24.4	200.1
2017	118.9	72.1	27.0	218.0

Table 4.13: Prediction of Weights for Each Region in 2019 (mhl)

	Volume Sold in Europe	Volume Sold in America	Volume Sold in Asia Pacific	Sum
2014	59%	29%	12%	100%
2015	60%	30%	11%	100%
2016	58%	29%	12%	100%
2017	55%	33%	12%	100%
2019	58%	30%	12%	100%

As we can see from the Table 4.13 that we predict the weights for each region in 2019 by calculating the average value for each region from 2014 to 2017.

4.3.3 Prediction of Operating Revenues for Each Region

After finishing the procedure for prediction of average price and weights for each currency and each region, we will calculate the operating revenues for each region. And eventually all the currency unit for each region will be transformed into euro. We will complete these calculations based on the following formula (4.6) and (4.7).

$$OR_D = AP_D \cdot TV \cdot W, \tag{4.6}$$

$$OR_F = AP_F \cdot TV \cdot W \cdot E_{D/F}\ , \tag{4.7}$$

where OR_D represents operating revenues in domestic currency, OR_F represents operating revenues in foreign currency and W represents the weights for total volume sold of selected region accounting for the total volume sold.

Due to the prediction of total volume sold is for four quarters of the year 2019, we will then get the results of operating revenues for four quarters as well. The following Table 4.14, Table 4.15 and Table 4.16 shows the final results of selected 10 scenarios of prediction for operating revenues.

Table 4.14: Prediction of Operating Revenues for 1st Quarter and 2nd Quarter in Year 2019 from 10 Scenarios (million euro)

	Q1				Q2			
	Europe	**America**	**Asia**	**SUM**	**Europe**	**America**	**Asia**	**SUM**
S1	3592.3	1818.8	707.1	6118.2	3768.5	1940.2	747.1	6455.8
S2	3587.2	1839.5	714.0	6140.6	3507.2	1828.7	703.1	6039.0
S3	3475.8	1749.1	680.5	5905.5	3549.3	1783.6	688.9	6021.8
S4	3256.2	1662.8	645.8	5564.8	3376.2	1723.2	664.2	5763.6
S5	3421.6	1747.9	678.8	5848.2	3490.7	1819.4	699.5	6009.6
S6	3555.9	1828.3	709.4	6093.6	3705.2	1941.1	745.8	6392.1
S7	3593.0	1832.0	711.6	6136.6	3464.7	1813.5	696.9	5975.0
S8	3337.4	1683.3	654.7	5675.4	3491.0	1783.2	687.3	5961.5
S9	3342.9	1721.6	667.9	5732.3	3504.0	1783.0	687.6	5974.6
S10	3480.4	1783.1	692.2	5955.6	3450.4	1742.6	672.6	5865.6

Table 4.15: Prediction of Operating Revenues for 3rd Quarter and 4th Quarter in Year 2019 from 10 Scenarios (million euro)

	Q3				Q4			
	Europe	**America**	**Asia**	**SUM**	**Europe**	**America**	**Asia**	**SUM**
S1	3801.3	1938.1	741.6	6481.0	3741.8	1901.5	722.5	6365.8
S2	3624.9	1848.5	707.3	6180.7	3630.6	1843.6	700.5	6174.6
S3	3680.3	1871.7	716.4	6268.4	3901.6	1944.5	740.5	6586.6
S4	3528.2	1815.5	693.9	6037.6	3722.4	1881.3	715.2	6318.9
S5	3714.6	1847.4	709.0	6271.0	3850.5	1877.5	716.9	6445.0
S6	3599.0	1895.6	722.5	6217.1	3585.1	1871.3	708.6	6165.0
S7	3502.1	1868.4	711.0	6081.5	3410.9	1855.1	699.0	5965.0
S8	3715.3	1909.2	729.8	6354.3	3793.1	1965.1	744.9	6503.0
S9	3512.0	1794.7	686.5	5993.2	3743.3	1988.0	751.2	6482.5
S10	3624.1	1788.8	687.2	6100.0	3718.2	1796.9	686.9	6202.0

Table 4.16: Prediction of Operating Revenues for the Whole Year 2019 from 10 Scenarios (million euro)

	Q1+Q2+Q3+Q4
	SUM
S1	25420.9
S2	24535.0
S3	24782.3
S4	23684.9
S5	24573.8
S6	24867.8
S7	24158.2
S8	24494.2
S9	24182.6
S10	24123.3

The Table 4.14 and Table 4.15 clearly shows us the prediction value of operating revenues for each region and for each quarter in year 2019, and the currency unit is expressed as domestic

currency euro of Heineken company. And Table 4.16 shows the total estimate value of operating revenues for all the regions in the whole year 2019.

4.4 Prediction of Operating Expenses

After completing the procedures of predicting the operating revenues, in this subchapter we will describe the procedures of predicting for the operating expenses.

As we have mentioned before that the Heineken company won't face the commodity risk or exchange rate risk when producing the beer, because the Heineken company has its own local supply chain of raw materials for producing beer. Thus, we will not consider about the factor of exchange rate risk when we predict the operating expenses. The following Table 4.17 shows the components of total operating expenses of Heineken company from year 2014 to 2017.

Table 4.17: Operating Expenses of Heineken Company from 2014 to 2017 (million euro)

	2014	2015	2016	2017
Raw materials	12053	12931	13003	13540
Personnel expenses	3080	3322	3263	3550
Amortization, depreciation and impairments	1437	1594	1817	1587
Total operating expenses	16570	17847	18083	18677

As we can see from the Table 4.17 that there exist three types of operating expenses in Heineken company: raw materials, personnel expenses and amortization, depreciation and impairments. Next, we will make a prediction for these three types of operating expenses separately.

4.4.1 Prediction of Raw Materials

As we have known that the raw materials are regarded as variable costs which will be changed according to the change of volume. Thus, we will calculate the proportion of raw materials accounting for the total operating revenues. Then, we will calculate the average value of these proportions. And we will make an assumption that the average value will represent the level of year 2019. Eventually, we will multiply the average value by the estimate operating revenue in each quarter of year 2019 to get the final results. The procedures will be shown in

the following Table 4.18.

Table 4.18: Proportion of Raw Materials Accounting for the Total Operating Revenues

	2014	2015	2016	2017
Raw materials	12053	12931	13003	13540
Operating revenue	19257	20511	20792	21888
Proportion	63%	63%	63%	62%
Average	63%			

As we can see from the Table 4.18 that average value of the proportion of raw materials accounting for the total operating revenues is 63%. Thus, it also means that in year 2019, the prediction of raw materials will be at the level of 63% of total operating revenues.

So, next we will continue to estimate the raw materials for four quarters of year 2019. The Table 4.19 shows the final results of it.

Table 4.19: Prediction of Raw Materials for Four Quarters of Year 2019 from 10 Scenarios (million euro)

	Q1	Q2	Q3	Q4	SUM
S1	3824.4	4035.4	4051.2	3979.2	15890.2
S2	3838.4	3774.9	3863.5	3859.6	15336.4
S3	3691.4	3764.1	3918.3	4117.2	15491.0
S4	3478.4	3602.7	3774.0	3949.8	14805.0
S5	3655.6	3756.5	3919.9	4028.6	15360.7
S6	3809.0	3995.6	3886.2	3853.6	15544.5
S7	3835.9	3734.9	3801.5	3728.6	15100.9
S8	3547.6	3726.4	3972.0	4064.9	15310.9
S9	3583.2	3734.6	3746.2	4052.1	15116.1
S10	3722.8	3666.5	3813.0	3876.8	15079.1

4.4.2 Prediction of Personnel Expenses

After the procedures of estimating raw materials, next we will predict the personnel expenses. On the contrary to the raw materials, the personnel expenses will not be changed according to the change of volume. Thus, we can't use the way of estimating the raw materials

to estimate the personnel expenses. Instead, we will simply calculate the average value of the personnel expenses from 2014 to 2017. Then, we assume that the value of personnel expenses in 2019 will be approximately the same as the level of the average value. The procedure will be shown in the following Table 4.20.

Table 4.20: Average Value of Personnel Expenses from 2014 to 2017 (million euro)

	2014	2015	2016	2017
Personnel expenses	3080	3322	3263	3550
Average	3303.8			

As we can see from the Table 4.20 that average value of the personnel expenses is 3303.8 million euro. Thus, it also means that in year 2019, the prediction of personnel expenses will also be 3303.8 million euro. And for each quarter, the prediction of personnel expenses will be 3303.8 divided by 4 which equals to 825.9 million euro.

4.4.3 Prediction of Amortization, Depreciation and Impairments

The procedure of prediction for amortization, depreciation and impairments will be similar to the prediction for personnel expenses due to the fact that amortization, depreciation and impairments will not be changed according to the change of volume, either. Which means that we will simply calculate the average value of the amortization, depreciation and impairments from 2014 to 2017. Then, we assume that the value of amortization, depreciation and impairments in 2019 will be approximately the same as the level of the average value. The procedure will be shown in the following Table 4.21.

Table 4.21: Average Value of Amortization, Depreciation and Impairments from 2014 to 2017 (million euro)

	2014	2015	2016	2017
Amortization, depreciation and impairments	1437	1594	1817	1587
Average	1608.8			

As we can see from the Table 4.21 that average value of the amortization, depreciation and impairments is 1608.8 million euro. Thus, it also means that in year 2019, the prediction of amortization, depreciation and impairments will also be 1608.8 million euro. And for each quarter, the prediction of amortization, depreciation and impairments will be 1608.8 divided by

4 which equals to 402.2 million euro.

4.5 Prediction of Net Operating Profits

After accomplishing all the procedures of predicting for operating revenues and operating expenses, we will continue the procedure of predicting the net operating profits which is also the main goal of this chapter.

4.5.1 Procedures for Prediction of Net Operating Profits

We will calculate the net operating profits based on the following formula (4.7).

$$NOP_t = OR_t - OE_t \ , \tag{4.7}$$

where NOP_t represents the net operating profits in time t, OE_t represents operating expenses in time t.

Then, combined with the above results of operating revenues and operating expenses, we will get the final results of prediction of net operating profits for each quarter during the year 2019. The final results will be shown in the Table 4.22.

Table 4.22: Prediction of Net Operating Profits in Year 2019 from 10 Scenarios (million euro)

	Q1	Q2	Q3	Q4	SUM
S1	1065.7	1192.3	1201.7	1158.5	4618.2
S2	1074.1	1036.0	1089.1	1086.8	4286.1
S3	985.9	1029.5	1122.0	1241.3	4378.8
S4	858.2	932.7	1035.5	1140.9	3967.4
S5	964.5	1025.0	1123.0	1188.2	4300.6
S6	1056.5	1168.4	1102.8	1083.2	4410.9
S7	1072.6	1012.0	1051.9	1008.3	4144.8
S8	899.7	1006.9	1154.2	1210.0	4270.8
S9	921.0	1011.8	1018.8	1202.3	4154.0
S10	1004.7	971.0	1058.9	1097.1	4131.7

As is shown in the Table 4.22, there are 10 selected scenarios for the prediction of net operating profits. However, in our thesis, we have actually predicted 1000 scenarios for it. Thus, it's obviously very difficult to observe and analyze these 1000 results directly. In order

to make it easier for observing and analyzing the results, we will use the method of frequency analysis that we have mentioned in chapter 2. And the procedure of it will be described in the following subchapter.

4.5.2 Frequency Analysis of Net Operating Profits for Each Quarter

In this subchapter, we will apply the method of frequency analysis to analyze the net operating profits

Firstly, we will set 20 as the number of steps and 19 as the number of intervals in our thesis. Then we find the minimal value and the maximal value of these 1000 scenarios for each quarter. Next, we can calculate the equidistant interval for each quarter of year 2019 according to the formula (4.8).

$$EI = \frac{MAX-MIN}{N-1}, \tag{4.8}$$

where *EI* represents the equidistant interval, *MAX* and *MIN* represent the biggest and the lowest value in our total sample, and *N* represents the numbers of steps that we set.

And the results will be presented in the following Table 4.23.

Table 4.23: Frequency Analysis Factors for Each Quarter in 2019

	MIN	MAX	Numbers of Steps	Equidistant Interval
Q1	727.4	1413.8	20	36.1
Q2	730.9	1496.4	20	40.3
Q3	651.3	1664.8	20	53.3
Q4	604.4	1747.5	20	60.2

After completing the calculation of these frequency analysis factors, we will continue calculating each value of interval based on the formula (4.9).

$$I_n = I_{n-1} + EI, \tag{4.9}$$

where I_{n-1} represents the value of interval for the position n-1, and I_n represents the value of interval for the position n.

And the following Table 4.24, Table 4.25, Table 4.26, and Table 4.27 separately shows the final results of frequency and probability of net operating profits for each quarter in year 2019.

Table 4.24: Frequency and Probability of Net Operating Profits for 1st Quarter in 2019

Net operating profits Q1 (Millions of EUR)	Frequency	Probability
727.4	1	0.1%
763.5	0	0.0%
799.6	0	0.0%
835.7	9	0.9%
871.9	31	3.1%
908.0	40	4.0%
944.1	94	9.4%
980.2	123	12.3%
1016.4	153	15.3%
1052.5	158	15.8%
1088.6	143	14.3%
1124.8	131	13.1%
1160.9	51	5.1%
1197.0	36	3.6%
1233.1	15	1.5%
1269.3	11	1.1%
1305.4	2	0.2%
1341.5	1	0.1%
1377.6	0	0.0%
1413.8	1	0.1%
SUM	1000	100.0%

As we can see from the Table 4.24, the most frequent value of net operating profits among these 1000 scenarios is 1052.5 million euro for the 1st quarter. Moreover, for the interval between 980.2 and 1124.8 million euro, there exists the values of net operating profits with highest frequency.

Table 4.25: Frequency and Probability of Net Operating Profits for 2nd Quarter in 2019

Net operating profits Q2 (Millions of EUR)	Frequency	Probability
730.9	1	0.1%
771.2	3	0.3%
811.5	12	1.2%
851.7	24	2.4%
892.0	42	4.2%
932.3	70	7.0%
972.6	98	9.8%
1012.9	104	10.4%
1053.2	130	13.0%
1093.5	121	12.1%
1133.8	119	11.9%
1174.1	98	9.8%
1214.3	71	7.1%
1254.6	44	4.4%
1294.9	22	2.2%
1335.2	15	1.5%
1375.5	18	1.8%
1415.8	3	0.3%
1456.1	4	0.4%
1496.4	1	0.1%
SUM	1000	100.0%

As we can see from the Table 4.25, the most frequent value of net operating profits among these 1000 scenarios is 1053.2 million euro for the 2nd quarter. Moreover, for the interval between 972.6 and 1174.1 million euro, there exists the values of net operating profits with highest frequency.

Table 4.26: Frequency and Probability of Net Operating Profits for 3rd Quarter in 2019

Net operating profits Q3 (Millions of EUR)	Frequency	Probability
651.3	1	0.1%
704.6	1	0.1%
758.0	6	0.6%
811.3	27	2.7%
864.7	33	3.3%
918.0	71	7.1%
971.4	110	11.0%
1024.7	95	9.5%
1078.0	129	12.9%
1131.4	126	12.6%
1184.7	113	11.3%
1238.1	104	10.4%
1291.4	72	7.2%
1344.8	47	4.7%
1398.1	25	2.5%
1451.4	20	2.0%
1504.8	7	0.7%
1558.1	7	0.7%
1611.5	4	0.4%
1664.8	2	0.2%
SUM	1000	100.0%

As we can see from the Table 4.26, the most frequent value of net operating profits among these 1000 scenarios is 1078.0 million euro for the 3rd quarter. Moreover, for the interval between 971.4 and 1238.1 million euro, there exists the values of net operating profits with highest frequency.

Table 4.27: Frequency and Probability of Net Operating Profits for 4th Quarter in 2019

Net operating profits Q4 (Millions of EUR)	Frequency	Probability
604.4	1	0.1%
664.5	3	0.3%
724.7	2	0.2%
784.9	12	1.2%
845.0	37	3.7%
905.2	55	5.5%
965.4	104	10.4%
1025.5	105	10.5%
1085.7	103	10.3%
1145.9	111	11.1%
1206.0	132	13.2%
1266.2	100	10.0%
1326.4	81	8.1%
1386.5	61	6.1%
1446.7	37	3.7%
1506.8	27	2.7%
1567.0	15	1.5%
1627.2	5	0.5%
1687.3	5	0.5%
1747.5	4	0.4%
SUM	1000	100.0%

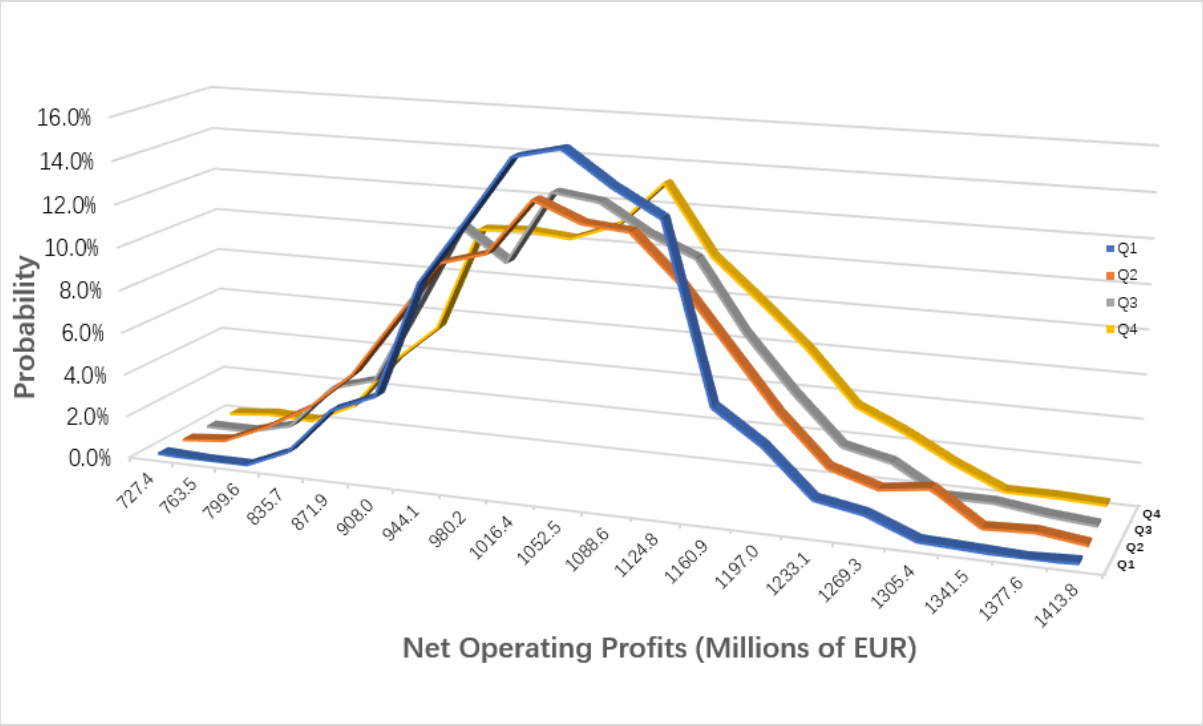
As we can see from the Table 4.27, the most frequent value of net operating profits among these 1000 scenarios is 1206.0 million euro for the 4th quarter. Moreover, for the interval between 965.4 and 1266.2 million euro, there exists the values of net operating profits with highest frequency.

From Table 4.24 to Table 4.27, we can clearly see the results of frequency analysis of net operating profits for each quarter in 2019. Moreover, for each quarter, the sum of frequency equals to 1000 and the sum of probability equals to 100% which demonstrate the correctness of our frequency analysis for it.

After the procedure for analyzing each quarter separately, we will create a new figure

which contains all of these four quarters. Such figure will be more comparable and specific for us to observe and analyze. The results will be shown in Figure 4.9.

Figure 4.9: Probability Distribution of Net Operating Profits for 4 Quarters in 2019



As is shown from the Figure 4.9, for all these four quarters, the values of highest probability of net operating profits are in the interval between 944.1 and 1124.8 million euro. And the probability is between 10% and 14%.

4.5.3 Frequency Analysis of Net Operating Profits for the Whole Year

The procedure of apply frequency analysis method to the net operating profits for the whole year 2019 is similar to the procedure for each quarter. Thus, we will follow the steps of above subchapter.

Firstly, we will calculate the frequency analysis factors for the whole year. And the results are shown in the Table 4.28.

Table 4.28: Frequency Analysis Factors for the Whole Year 2019

MIN	MAX	Numbers of Steps	Equidistant Interval
2850.3	6103.9	20	171.2

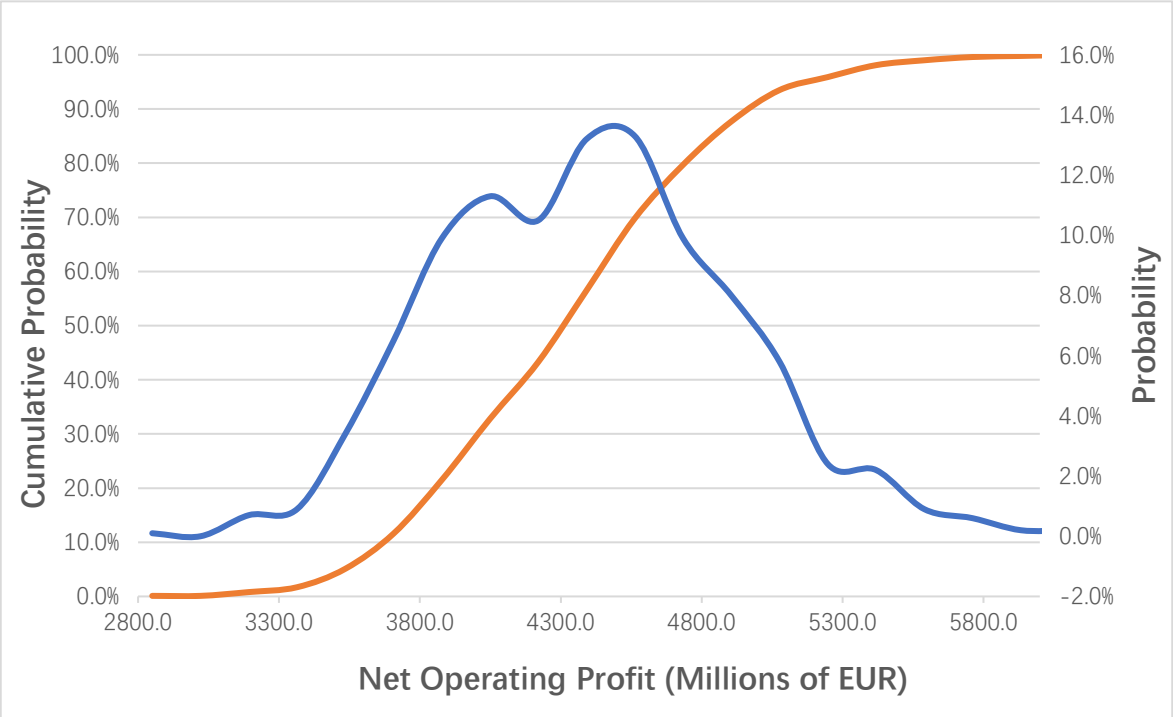
Next, we will continue calculating each value of interval, as well as the frequency and probability for the whole year 2019. And the results are shown in the following Table 4.29.

Table 4.29: Frequency and Probability of Net Operating Profits for the Whole Year 2019

Net operating profits 2019 (Millions of EUR)	Frequency	Probability	Cumulative Probability
2850.3	1	0.1%	0.1%
3021.6	0	0.0%	0.1%
3192.8	7	0.7%	0.8%
3364.1	9	0.9%	1.7%
3535.3	34	3.4%	5.1%
3706.5	65	6.5%	11.6%
3877.8	99	9.9%	21.5%
4049.0	113	11.3%	32.8%
4220.3	105	10.5%	43.3%
4391.5	132	13.2%	56.5%
4562.8	133	13.3%	69.8%
4734.0	99	9.9%	79.7%
4905.2	80	8.0%	87.7%
5076.5	58	5.8%	93.5%
5247.7	24	2.4%	95.9%
5419.0	22	2.2%	98.1%
5590.2	9	0.9%	99.0%
5761.4	6	0.6%	99.6%
5932.7	2	0.2%	99.8%
6103.9	2	0.2%	100.0%
SUM	1000	100.0%	

Differ from the frequency analysis for each quarter, when we create the table of frequency and probability of net operating profits for the whole year, we add another item which is called the cumulative probability. And the cumulative probability refers to the value of a random variable falls within a specified range. For instance, from the Table 4.29 we can see that there is only 5.1% probability that the net operating profits will be lower than 3535.3 million euro. In other word, it also means that there will be approximately 95% probability that the net operating profits will be higher than 3535.3 million euro. And the results of Table 4.29 can also be shown in the following Figure 4.10.

Figure 4.10: Probability and Cumulative Probability Distribution of Net Operating Profits in 2019



In the Figure 4.10, the blue line represents the probability of net operating profits in 2019, and the orange line represents the cumulative probability of net operating profits in 2019. And the values of highest probability of net operating profits in the whole year 2019 are in the interval between 3800.0 and 4700.0 million euro. And the probability is between 10% and 14%.

4.6 Sensitivity Analysis of Net Operating Profits

The sensitivity analysis refers to examine how different values of independent variables will influence a particular dependent variable under some given hypotheses. In our thesis, we will mainly focus on how the change of demand will affect the change of net operating profits in the year 2019.

When we make the change of demand, we will mainly concentrate on the change of mean and standard deviation of the demand. Moreover, the amount of the change will be set as 40%.

Next, we will conduct the sensitivity analysis of net operating profits under the first assumption which refers to increase the mean value of demand by 40%, while other variables will be constant. The results are shown in the Table 4.30.

Table 4.30: Increase Mean Value of Demand by 40%

Δ	40%
Mean	6.6494%
(↑Δ) Mean	9.3091%

As is shown in the Table 4.30, the original mean value is 6.6494%, after the procedure of increasing it by 40%, the new mean value is 9.3091%. After changing the mean value, the new results of frequency and probability of net operating profits in the year 2019 will be presented in the following Table 4.31.

Table 4.31: Frequency and Probability of Net Operating Profits for the Whole Year 2019 (Increase Mean Value of Demand by 40%)

OP(SUM) + 40 % Δ	Frequency	Probability	Cumulative Probability
2978.0	1	0.1%	0.1%
3152.5	0	0.0%	0.1%
3326.9	7	0.7%	0.8%
3501.4	9	0.9%	1.7%
3675.9	33	3.3%	5.0%
3850.4	66	6.6%	11.6%
4024.8	99	9.9%	21.5%
4199.3	112	11.2%	32.7%
4373.8	105	10.5%	43.2%
4548.2	133	13.3%	56.5%
4722.7	132	13.2%	69.7%
4897.2	100	10.0%	79.7%
5071.7	78	7.8%	87.5%
5246.1	60	6.0%	93.5%
5420.6	24	2.4%	95.9%
5595.1	22	2.2%	98.1%
5769.5	9	0.9%	99.0%
5944.0	6	0.6%	99.6%
6118.5	2	0.2%	99.8%
6293.0	2	0.2%	100.0%
SUM	1000	100.0%	
Equidistant interval	174.5		

Then, we will conduct the sensitivity analysis of net operating profits under the second assumption which refers to decrease the mean value of demand by 40%, while other variables will be constant. The results are shown in the Table 4.32.

Table 4.32: Decrease Mean Value of Demand by 40%

Δ	40%
Mean	6.6494%
(↓Δ) Mean	3.9896%

As is shown in the Table 4.32, the original mean value is 6.6494%, after the procedure of decreasing it by 40%, the new mean value is 3.9896%. After changing the mean value, the new results of frequency and probability of net operating profits in the year 2019 will be presented in the following Table 4.33.

Table 4.33: Frequency and Probability of Net Operating Profits for the Whole Year 2019 (Decrease Mean Value of Demand by 40%)

OP(SUM) - 40 % Δ	Frequency	Probability	Cumulative Probability
2725.2	1	0.1%	0.1%
2893.3	0	0.0%	0.1%
3061.3	7	0.7%	0.8%
3229.4	9	0.9%	1.7%
3397.5	34	3.4%	5.1%
3565.6	65	6.5%	11.6%
3733.6	99	9.9%	21.5%
3901.7	113	11.3%	32.8%
4069.8	105	10.5%	43.3%
4237.9	134	13.4%	56.7%
4406.0	133	13.3%	70.0%
4574.0	96	9.6%	79.6%
4742.1	81	8.1%	87.7%
4910.2	58	5.8%	93.5%
5078.3	24	2.4%	95.9%
5246.3	22	2.2%	98.1%
5414.4	9	0.9%	99.0%
5582.5	6	0.6%	99.6%
5750.6	2	0.2%	99.8%
5918.7	2	0.2%	100.0%
SUM	1000	100.0%	
Equidistant interval	168.1		

Next, we will conduct the sensitivity analysis of net operating profits under the third assumption which refers to increase the standard deviation of demand by 40%, while other

variables will be constant. The results are shown in the Table 4.34.

Table 4.34: Increase Standard Deviation of Demand by 40%

Δ	40%
Standard Deviation	7.6326%
(↑Δ) Standard Deviation	10.6856%

As is shown in the Table 4.34, the original standard deviation is 7.6326%, after the procedure of increasing it by 40%, the new standard deviation is 10.6856%. After changing the standard deviation, the new results of frequency and probability of net operating profits in the year 2019 will be presented in the following Table 4.35.

Table 4.35: Frequency and Probability of Net Operating Profits for the Whole Year 2019 (Increase Standard Deviation of Demand by 40%)

OP(SUM) + 40 % Δ	Frequency	Probability	Cumulative Probability
2343.3	1	0.1%	0.1%
2581.4	0	0.0%	0.1%
2819.6	7	0.7%	0.8%
3057.7	13	1.3%	2.1%
3295.9	39	3.9%	6.0%
3534.0	64	6.4%	12.4%
3772.1	111	11.1%	23.5%
4010.3	114	11.4%	34.9%
4248.4	112	11.2%	46.1%
4486.6	137	13.7%	59.8%
4724.7	124	12.4%	72.2%
4962.9	93	9.3%	81.5%
5201.0	75	7.5%	89.0%
5439.1	51	5.1%	94.1%
5677.3	20	2.0%	96.1%
5915.4	22	2.2%	98.3%
6153.6	7	0.7%	99.0%
6391.7	6	0.6%	99.6%
6629.8	2	0.2%	99.8%
6868.0	2	0.2%	100.0%
SUM	1000	100.0%	
Equidistant interval	238.1		

Then, we will conduct the sensitivity analysis of net operating profits under the fourth

assumption which refers to decrease the standard deviation of demand by 40%, while other variables will be constant. The results are shown in the Table 4.36.

Table 4.36: Increase Standard Deviation of Demand by 40%

Δ	40%
Standard Deviation	7.6326%
(↓Δ) Standard Deviation	4.5796%

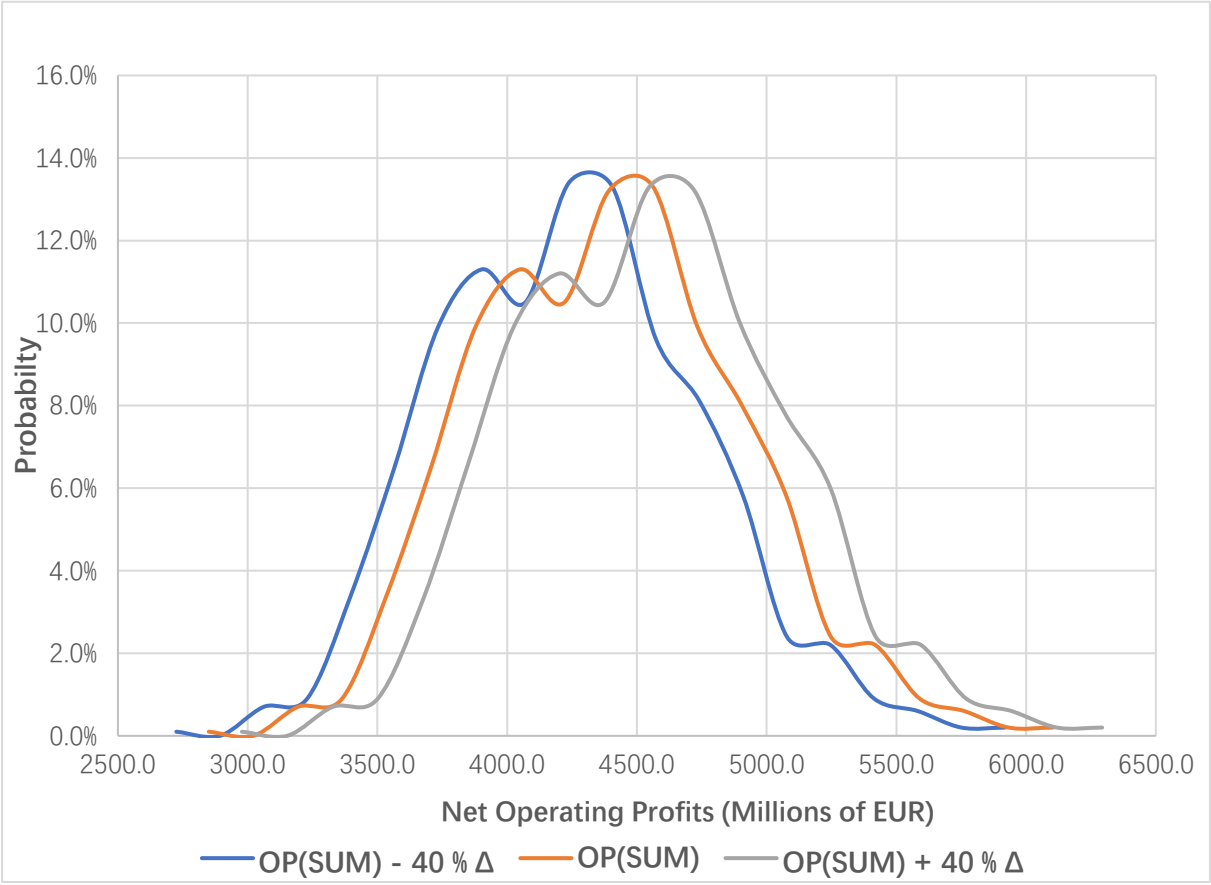
As is shown in the Table 4.36, the original standard deviation is 7.6326%, after the procedure of decreasing it by 40%, the new standard deviation is 4.5796%. After changing the standard deviation, the new results of frequency and probability of net operating profits in the year 2019 will be presented in the following Table 4.37.

Table 4.37: Frequency and Probability of Net Operating Profits for the Whole Year 2019 (Decrease Standard Deviation of Demand by 40%)

OP(SUM) - 40 % Δ	Frequency	Probability	Cumulative Probability
3398.1	1	0.1%	0.1%
3503.0	2	0.2%	0.3%
3607.9	5	0.5%	0.8%
3712.8	16	1.6%	2.4%
3817.7	24	2.4%	4.8%
3922.6	62	6.2%	11.0%
4027.5	106	10.6%	21.6%
4132.4	101	10.1%	31.7%
4237.3	103	10.3%	42.0%
4342.2	134	13.4%	55.4%
4447.1	126	12.6%	68.0%
4552.0	95	9.5%	77.5%
4656.9	88	8.8%	86.3%
4761.8	63	6.3%	92.6%
4866.7	25	2.5%	95.1%
4971.6	26	2.6%	97.7%
5076.5	13	1.3%	99.0%
5181.4	7	0.7%	99.7%
5286.3	2	0.2%	99.9%
5391.2	1	0.1%	100.0%
SUM	1000	100.0%	
Equidistant interval	104.9		

After completing the calculation of the new results of frequency and probability of net operating profits for the whole year 2019 under all changes, we will create four figures. In order to make these results more comparable and directly. The Figure 4.11 shows the comparison among the original probability of net operating profits and the new probability of net operating profits after the increase and decrease of mean value. The Figure 4.12 shows the comparison among the original cumulative probability of net operating profits and the new cumulative probability of net operating profits after the increase and decrease of mean value. The Figure 4.13 shows the comparison among the original probability of net operating profits and the new probability of net operating profits after the increase and decrease of standard deviation. And the Figure 4.14 shows the comparison among the original cumulative probability of net operating profits and the new cumulative probability of net operating profits after the increase and decrease of standard deviation.

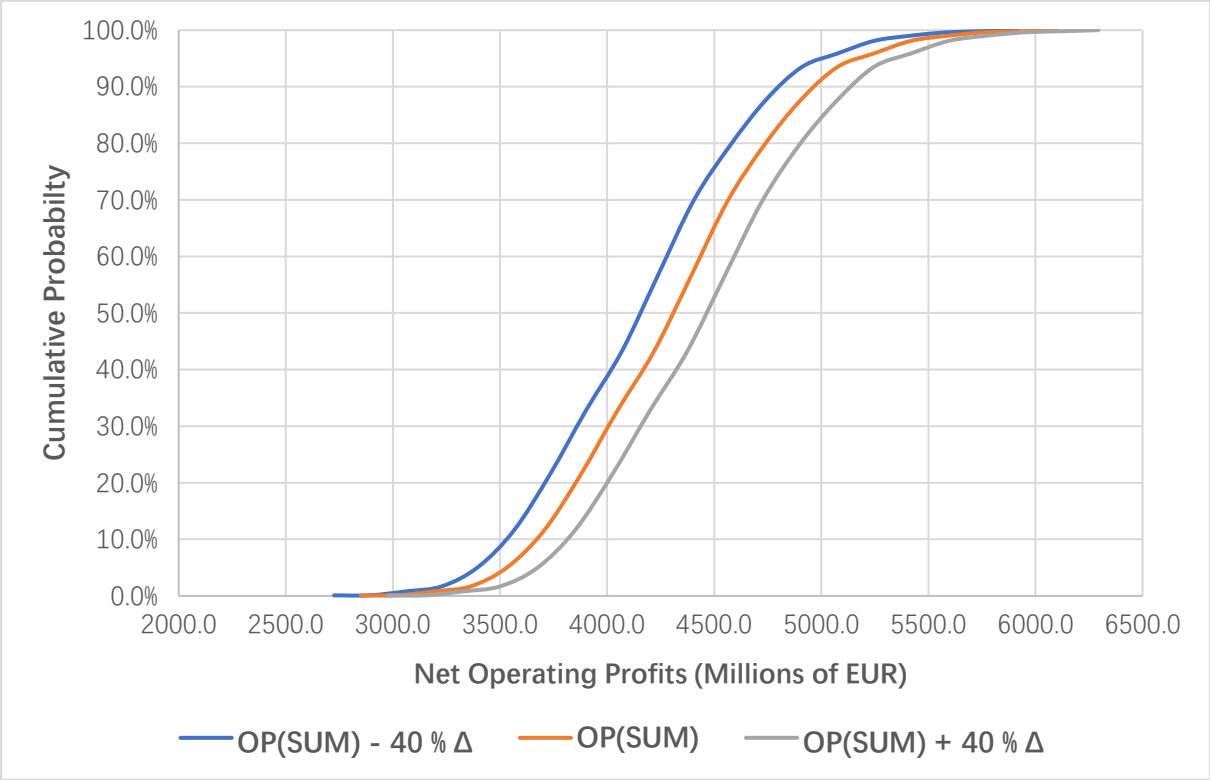
Figure 4.11: Probability Distribution of OP (Change of Mean Value of Demand +/- 40%)



As is shown in the Figure 4.11, with the change of mean value of demand, the original curve will shift left or right. It also indicates that under the circumstance of the same level of

probability, if the mean value is increased by 40%, the corresponding value of net operating profits will also increase. For instance, in our case, the original corresponding value of net operating profits with the highest probability is 4562.8 million euro. However, after the raise of mean value by 40%, the new corresponding value of net operating profits with the highest probability becomes 4722.7 million euro. Similarly, if the mean value is declined by 40%, the corresponding value of net operating profits will also decrease. In our case, after the decline of mean value by 40%, the new corresponding value of net operating profits with the highest probability becomes 4406.0 million euro.

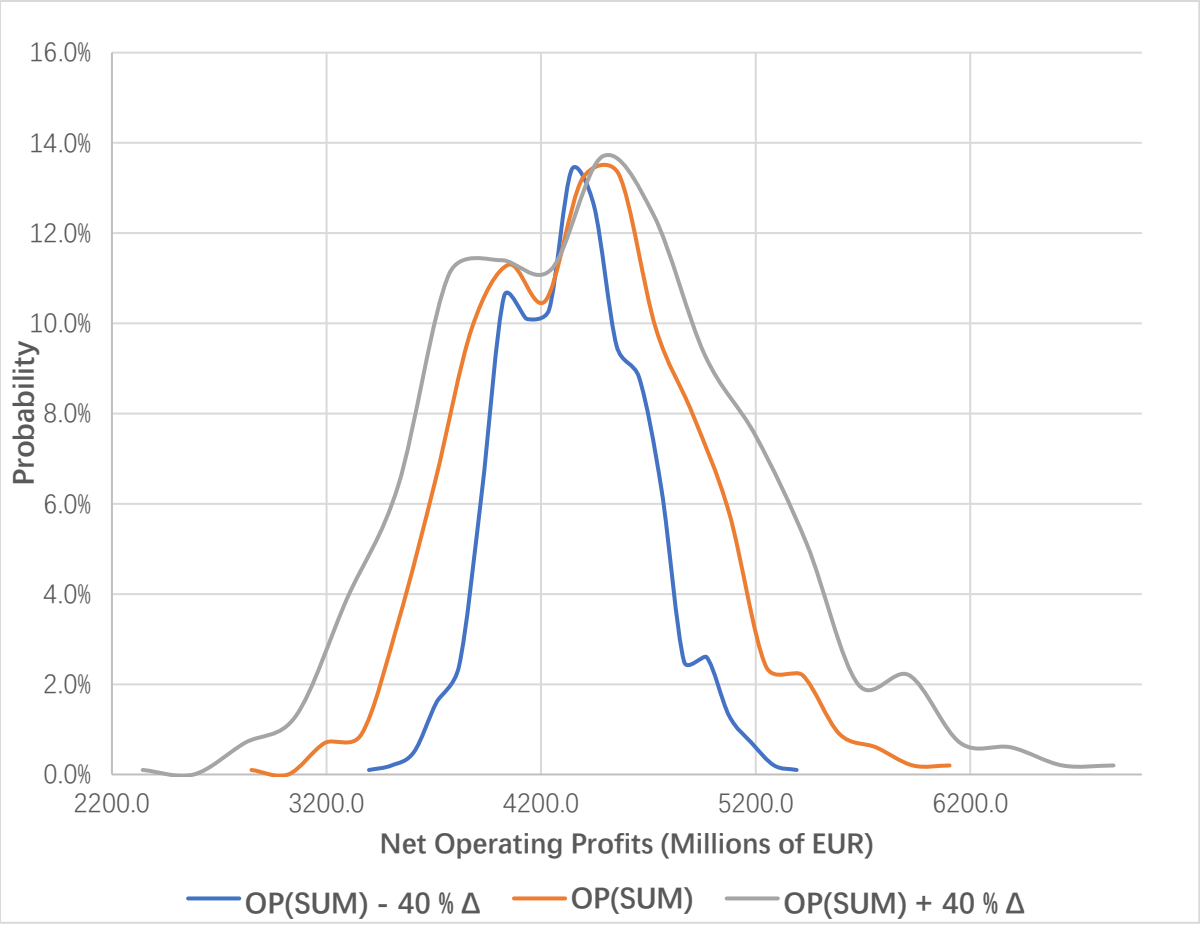
Figure 4.12: Cumulative Probability Distribution of OP (Change of Mean Value of Demand +/- 40%)



The Figure 4.12 shows the condition of cumulative probability after the change of mean value, with the change of mean value of demand, the original curve will shift left or right just like the case in probability. It also indicates that under the circumstance of the same level of cumulative probability, if the mean value is increased by 40%, the corresponding value of net operating profits will also increase. For instance, in our case, originally there is 11.6% probability that the net operating profits will be lower than 3706.5 million euro. In other word, it also means that there will be approximately 90% probability that the net operating profits will

be higher than 3706.5 million euro. Nevertheless, after the raise of mean value by 40%, there is 11.6% probability that the net operating profits will be lower than 3850.4 million euro. In other word, it also means that there will be approximately 90% probability that the net operating profits will be higher than 3850.4 million euro. Similarly, if the mean value is declined by 40%, the corresponding value of net operating profits will also decrease. In our case, after the decline of mean value by 40%, there is 11.6% probability that the net operating profits will be lower than 3565.6 million euro. In other word, it also means that there will be approximately 90% probability that the net operating profits will be higher than 3565.6 million euro.

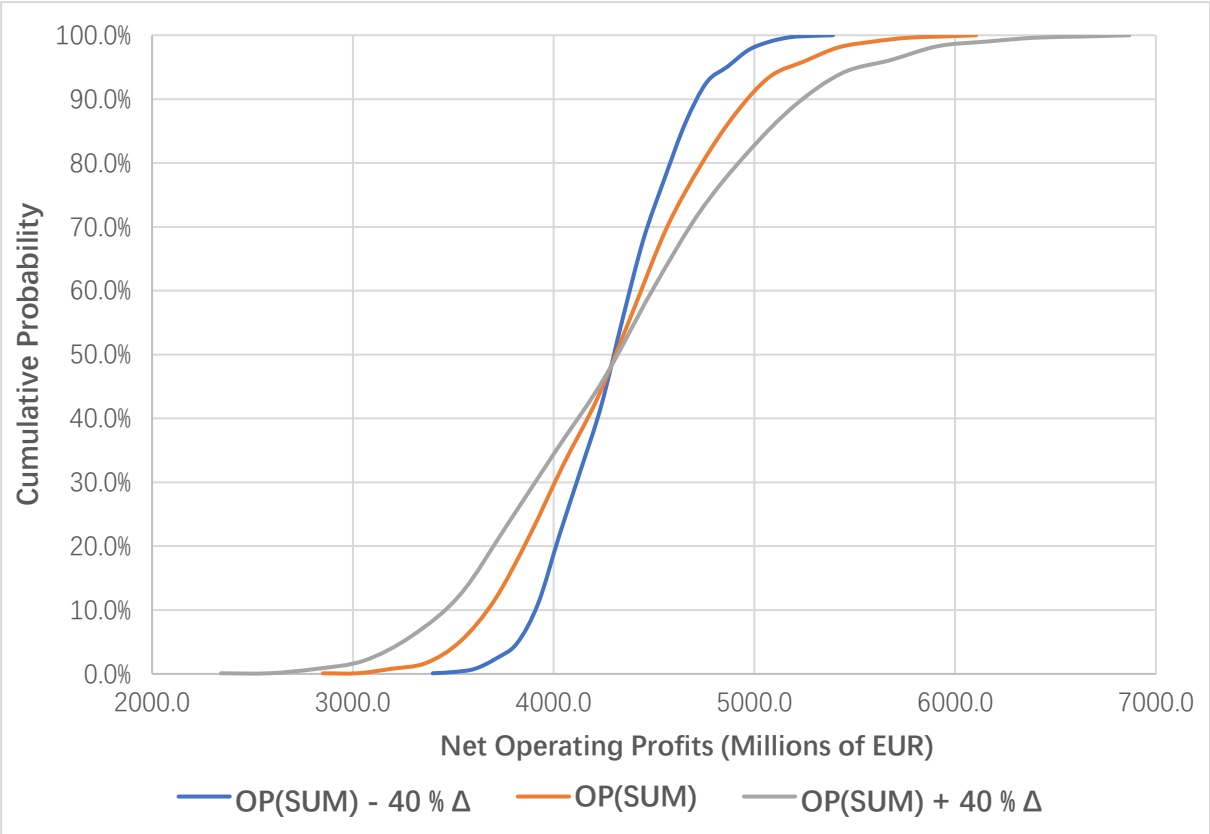
Figure 4.13: Probability Distribution of OP (Change of Standard Deviation of Demand +/- 40%)



The Figure 4.13 shows the condition of probability after the change of standard deviation, with the change of standard deviation of demand, on the contrary to the case in change of mean value, the curve will change its width instead of shifting towards left or right. It also indicates that under the circumstance of the same level of probability, if the standard deviation is

increased by 40%, the corresponding interval of net operating profits will also increase. For instance, in our case, the original interval of highest probability with 10% to 14% of net operating profits are in the interval between 3877.8 and 4734.0 million euro. However, after the raise of standard deviation by 40%, the new interval of highest probability with 10% to 14% of net operating profits are in the interval between 3772.1 and 4962.9 million euro. Similarly, if the standard deviation is declined by 40%, the corresponding interval of net operating profits will also decrease. In our case, after the decline of standard deviation by 40%, the new interval of highest probability with 10% to 14% of net operating profits are in the interval between 4027.5 and 4552.0 million euro.

Figure 4.14: Cumulative Probability Distribution of OP (Change of Standard Deviation of Demand +/- 40%)



The Figure 4.14 shows the condition of cumulative probability after the change of standard deviation, with the change of standard deviation of demand, the curve will change its width instead of shifting towards left or right just like the case in probability. It also indicates that under the circumstance of the same level of cumulative probability, if the standard deviation is increased by 40%, the corresponding interval of net operating profits will also increase. For

instance, in our case, originally for the interval of cumulative probability between approximately 10% and 20%, the corresponding interval of net operating profits is between 3706.5 and 3877.8 million euro. Nevertheless, after the raise of standard deviation by 40%, for the interval of cumulative probability between approximately 10% and 20%, the new corresponding interval of net operating profits is between 3534.0 and 3772.1 million euro. Similarly, if the standard deviation is declined by 40%, the corresponding interval of net operating profits will also decrease. In our case, after the decline of standard deviation by 40%, the new corresponding interval of net operating profits is between 3922.6 and 4027.5 million euro.

4.7 Comparison of Net Operating Profits between 2018 and 2019

After completing all the procedures of above subchapters, we have gotten the results of the main goal of this chapter, the prediction of net operating profits for year 2019 under some inevitable risks. We have also conducted the frequency analysis and sensitivity analysis for the estimated net operating profits. So, in this subchapter, we will accomplish the last part of the whole chapter 4. We will calculate how much probability that the net operating profits in year 2019 will be higher than net operating profits in year 2018.

Before we start, we will first make a summarization about some key statistics for net operating profits in 2019. The following Table 4.38 shows the result for it.

Table 4.38: Key Statistics for Net Operating Profits in 2019 (million euro)

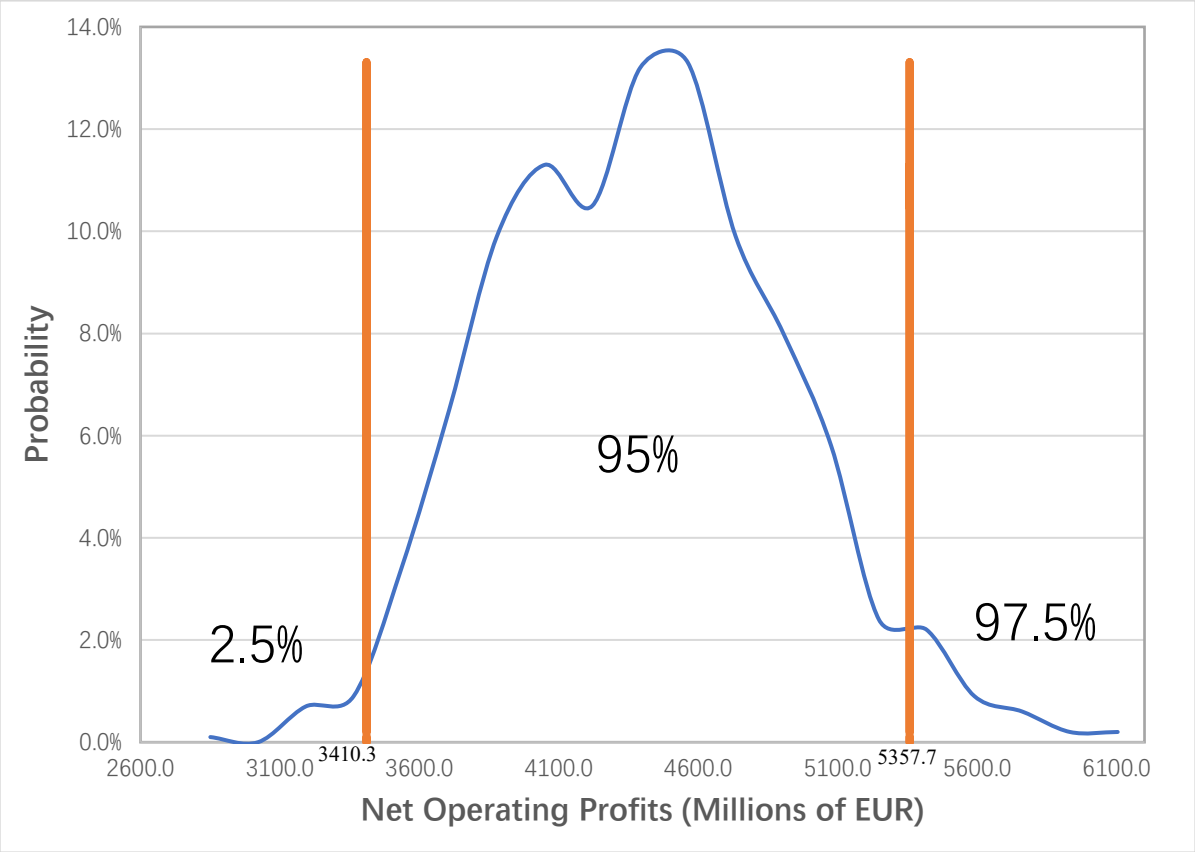
	Net Operating Profits (SUM)
Mean	4315.1
Median	4308.7
Standard deviation	505.0
Min	2850.3
Max	6103.9
2.5% value	3410.3
97.5% value	5357.7

As is shown in the Table 4.38, we can see that in average, the mean value which represents

that central tendency for the net operating profits in 2019 will be 4315.1 million euro. The middle value of the net operating profits in 2019 will be 4308.7. And the standard deviation which also refers to the dispersion of the net operating profits in 2019 relative to its mean will be 505.0 million euro.

Next, we will create the Figure 4.15 to show the probability distribution of net operating profits in 2019 with 2.5% and 97.5% percentile.

Figure 4.15: Probability Distribution of Net Operating Profits in 2019 with 2.5% and 97.5% Percentile



As we can see from the Figure 4.15, the middle part which between these two orange lines represents that there is 95% probability that the net operating profits in 2019 will be in the interval between 3410.3 million euro and 5357.7 million euro.

Then, we will calculate what the probability will be if the net operating profits in 2019 is higher than that in 2018.

Firstly, we find the net operating profits of the half year of 2018 from the half year report of Heineken company is 1754 million euro. We assume that the net operating profits of the next half year of 2018 will be similar to 1754 million euro. So, the net operating profits of the whole

year 2018 will be twice as much as 1754 million euro, and the final result is 3508 million euro. Next, we will sort the value of net operating profits from small to large. Then, we will search for the data of predicted net operating profits in 2019 to find out what is the position of the number 3508 or very similar to 3508. And we find out that there are 45 values lower than 3508.28. The results for estimated probability of net operating profits in 2019 when comparing with 2018 will be shown in the Table 4.39.

Table 4.39: Probability of Net Operating Profits in 2019 for Exceeding or Lowering than 2018

Net operating profits (million euro)	Probability
Net operating profits<3508	4.5%
Net operating profits≥3508	95.5%

Eventually, from the Table 4.39, we can say that there is 4.5% possibility that the net operating profits in 2019 will be lower than net operating profits in 2018. And 95.5% possibility that the net operating profits in 2019 will be equal or higher than net operating profits in 2018. Which represents a good sign for Heineken company. Because the result demonstrates that even under the various of market risk, there is still a very high probability for Heineken company to achieve better financial performance in 2019 than 2018.

5. Conclusion

Standing as the most international brewer around the world, it's obvious that the Heineken company faces various market risk while operating import and export business. In particular, currency risk is the most threatening type of market risk for the Heineken company owing to wide range of international markets. Therefore, quantifying and managing the corresponding risk is quite necessary for the Heineken company. By applying the CorporateMetrics methodology to manage market risk, the Heineken company can take full advantage of being more and more international instead of undertaking too much losses owing to various of market risk.

The main goal of this thesis is to predict the probability distribution of net operating profits for Heineken company in 2019 by applying the CorporateMetrics methodology.

For the theoretical part, in chapter 2 and chapter 3, we made a thorough description for the CorporateMetrics methodology as well as the characteristics of Heineken company. These parts indeed provided theoretical support for the following chapter 4.

For the practical part, in chapter 4, firstly, we specified the risk that Heineken company will face. The risk refers to exchange rate risk and demand risk. Next, we observed the revolution of the exchange rate of EUR/USD and EUR/CNY, as well as the demand from the past. Then, according to the trend of the revolution, we selected Geometric Brownian motion as the financial model for generating scenarios of the predicted exchange rate and demand. After the procedures of scenarios generation, we predicted the operating revenues, operating expenses based on various formulas which we mentioned before. According to the predicted operating revenues and operating expenses, finally we got the results of predicted net operating profits in 2019. Then, we conducted frequency analysis for net operating profits. After that we created the probability distribution for it. And we also conducted the sensitivity analysis for net operating profits under the condition of change of mean value as well as standard deviation of demand by 40%. In the end, we made a summarization about some key statistics for net operating profits in 2019. Furthermore, we also created the figure of probability distribution of net operating profits in 2019 with 2.5% and 97.5% percentile. The figure illustrated that there was 95% probability that the net operating profits in 2019 would be in the interval between

3410.3 million euro and 5357.7 million euro. And compared with 2018, we found out that there was only 4.5% possibility that the net operating profits in 2019 would be lower than net operating profits in 2018, and 95.5% possibility that the net operating profits in 2019 would be equal or higher than net operating profits in 2018. Therefore, even facing the various of market risk, there still would be a very high probability for Heineken company to achieve better financial performance in 2019 than 2018.

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List of Abbreviations

AP	Average Price
CFaR	Cash-Flow-at-Risk
CNY	Chinese Yuan
E	Exchange rate
EaR	Earning at Risk
EI	Equidistant Interval
EPSaR	Earnings-per-Share-at-Risk
EUR	Euro
MHL	Million Hectoliters
NOP	Net Operating Profit
OE	Operating Expense
OR	Operating Revenue
TV	Total Volume
USD	United States Dollar
VaR	Value at Risk
W	Weight

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Ostrava dated .....26.04.2019.....

徐依雯 Yiwen Xu

Bc. Yiwen Xu

List of Annexes

Annex 1: Income statement of Heineken company (million euro)

	2014	2015	2016	2017
Revenue	19 257	20 511	20 792	21 888
Other income	93	411	46	141
Raw materials, consumables and services	-12 053	-12 931	-13 003	-13 540
Personnel expenses	-3 080	-3 322	-3 263	-3 550
Amortization, depreciation and impairments	-1 437	-1 594	-1 817	-1 587
Total expenses	-16 570	-17 847	-18 083	-18 677
Operating profits	2 755	3 075	2 755	3 352
Interest income	48	60	60	72
Interest expenses	-457	-412	-419	-468
Other net finance income/expenses	-79	-57	-134	-123
Net finance expenses	-488	-409	-493	-519
Share of profit of associates and joint venture	148	172	150	75
Profit before income tax	2440	2838	2412	2908
Income tax expense	-732	-697	-673	-755
Profit	1708	2141	1739	2153